SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JULY 11, 1902.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE fifty-first meeting, held in Pittsburgh, from June 28 to July 3, may be held to be fairly typical of the general development of the Association during the last few years, and as one which goes far toward realizing some of the more serious purposes of the organization.

The total number of members in attendance was 431, which places the meeting far up toward the head of the list, so far as this feature is to be taken into account, and the roll includes an unusual proportion of the worthiest names among American men of science. Especially large attendance in physics, chemistry, mechanics and engineering may be attributed to the opportunity afforded the members of inspecting the great number of manufacturing establishments in and about Pittsburgh, which exhibit some of the most modern and interesting examples of the applications of the branches in question. This feature

of the meeting was most fully exploited by the local committee, about fifty excursions having been arranged, some of which entailed the charter and use of large river steamers for an entire day. The arrangements for the excursions and for the general entertainment of the members were on a larger scale than anything attempted at recent meetings of the Association, the local committee having collected and at its disposal a fund of $9,000.00 for this purpose. In face of such splendid liberality it must be added, somewhat ungraciously perhaps, that the agreement with the headquarters hotel was so loosely made that exorbitant rates were demanded of those who found it necessary to occupy quarters near the center of business interest of the Association.

A census of the papers read before the several sections and affiliated societies shows that 320 papers and addresses were given, in addition to the various lectures by the presiding officers of these organizations and the other special lectures in the evening sessions, which would probably bring the total up to nearly 350. An analysis of the special papers discloses the fact that their titles were distributed among the separate branches of science as follows:

Mathematics and astronomy		24
Physics		59
Physics	45	
American Physical Society	14	
Chemistry		69
Mechanical science and engineering		23
Geology and geography		26
Zoology		28
Botany		79
Section G	26	
Botanical Club	23	
Botanical Society of America	30	
Anthropology		30
Social and economic science		22

The membership shows a steady increase, the total number at the close of the sessions being about 3,500 (as compared with about 2,800 at the close of the Denver meeting, September 1, 1902), and the financial affairs of the Association are also in a very satisfactory condition. A notable event in this connection was the transfer by the request of the permanent secretary of $2,000.00 from his funds to the permanent fund in the hands of the treasurer, a result largely due to the skillful business management of the affairs of the Association by the secretary which called out a special vote of thanks by the council.

But little was done in the way of new legislation of importance. A single amendment to article 20 of the Constitution was proposed by which the words ' for one week or longer ' are to be omitted. This amendment will come up for action at the next meeting, and would have the effect of allowing meetings of less than a week's duration to be held under the action of the council. This section now reads as a result of an amendment completed at this meeting:

Art. 20. The Association shall hold a public meeting annually, for one week or longer, at such time and place as may be determined by vote of the General Committee, and the preliminary arrangements for each meeting shall be made by the Local Committee, in conjunction with the Permanent Secretary and such other persons as the Council may designate. But if suitable preliminary arrangements cannot be made, the Council may afterward change the time and place appointed by the General Committee, if such change is believed advisable by two thirds of the members present.

As a result of other amendments other portions of the constitution now read as follows:

Art. 9. The officers of the Association shall be elected by ballot by the General Committee from the fellows, and shall consist of a President, a Vice-President from each Section, a Permanent Secretary, a General Secretary, a Secretary of the Council, a Treasurer, and a Secretary of each Section; these, with the exception of the Permanent Secretary, the Treasurer, and the Secretaries of the Sections, shall be elected at each meeting for the following one, and, with the exception of the Treasurer and the Permanent Secretary, shall not be reeligible for the next two meetings. The term of office of the Permanent Secretary, of the

Treasurer, and of the Secretaries of the Sections shall be five years.

ART. 18. The Council shall consist of the Past Presidents, and the Vice-Presidents of the last two meetings, together with the President, the Vice-Presidents, the Permanent Secretary, the General Secretary, the Secretary of the Council, the Secretaries of the Sections, and the Treasurer of the current meeting, of one fellow elected from each Section by ballot on the first day of its meeting, of one fellow elected by each affiliated society, and one additional fellow from each affiliated society having more than twenty-five members who are fellows of the Association, and of nine fellows elected by the Council, three being annually elected for a term of three years, etc., etc.

ART. 23. Immediately on the organization of a Section there shall be a member or fellow elected by ballot after open nomination, who, with the Vice-President and Secretary and the Vice-President and Secretary of the preceding meeting and the members or fellows elected by ballot at the four preceding meetings shall form its Sectional Committee. The Sectional Committees shall have power to fill vacancies in their own numbers. Meetings of the Sections shall not be held at the same time with a General Session. The Sectional Committee may invite distinguished foreign associates present at any meeting to serve as honorary members of said Committee.

By the action of the general committee the next meeting of the Association will be held at Washington, D. C., December 29, 1902, to January 3, 1903, and will be the first held during the newly arranged convocation week as arranged and agreed to by more than fifty of the more prominent American universities. The general committee failed to take the usual step of indicating the probable time and place of the second meeting to follow, the consensus of opinion being that it would be profitable to await the result of the midwinter meeting before a decision is reached as to the desirability of such arrangements in the future.

The following officers were elected for the ensuing year:

President—Dr. Ira Remsen, Johns Hopkins University.

General Secretary—H. B. Ward, University of Nebraska.

Secretary of Council—Ch. Wardell Stiles, of Washington.

Vice-Presidents—Section A, George B. Halsted, Austin, Tex.; B, E. F. Nichols, Dartmouth College, N. H.; C, Charles Baskerville, Chapel Hill, N. C.; D, C. A. Waldo, Purdue University, Lafayette, Ind.; E, W. M. Davis, Harvard; F, C. W. Hargitt, Syracuse, N. Y.; G, F. V. Coville, Washington; H, G. M. Dorsey, Chicago; I, H. T. Newcomb, Philadelphia.

Section Secretaries—Section A, C. S. Howe, Cleveland; B, D. C. Miller, Cleveland; C, H. N. Stokes, Washington; D, A. K. Kingsbury, Worcester, Mass.; E, E. O. Hovey, New York; F, C. Judson Herrick, Granville, O.; G, C. J. Chamberlain, Chicago; H, R. H. Dixon, Cambridge, Mass.; I, Frank H. Hitchcock.

The Permanent Secretary and Treasurer are elected every five years. Dr. L. O. Howard, Washington, continues in the former office, and Professor R. S. Woodward, New York, in the latter.

The increasing number and size of the affiliated societies make it impossible to give at this place a full report of their proceedings. At the request of representatives of the organizations concerned, the American Anthropologic Association and the National Geographic Society were made affiliated societies for the Pittsburgh meeting.

The Botanical Society of America passed a series of resolutions on Monday, June 30, 1902, by which the sum of $500.00 is set aside from its yearly income, this year and every succeeding year, to be used in making grants in aid of investigations. This measure goes into operation at once, and applications from the members and associates of the Society may be sent to the secretary at any time. The funds of the Botanical Society of America consist of the accumulated dues and interest paid in by the members, and the grants in question probably constitute the only series ever offered in America, the money for which has been contributed wholly by a body of scientific workers alone.

Of the reports of committees, that on the relations of the journal SCIENCE to the Association may be taken to be of the greatest

importance to the general policy of the Association. The report as adopted by the Council is given below:

COMMITTEE ON THE RELATIONS OF THE JOURNAL SCIENCE WITH THE ASSOCIATION.

This committee is able to report that the arrangement by which SCIENCE is sent to members of the Association appears to be advantageous to the Association and to the advancement and diffusion of science in America. At the beginning of the New York meeting two years ago when the plan was adopted the membership of the Association was 1,721, whereas it is now about 3,450. The permanent secretary states that the money derived from the initiation fees of new members has sufficed to send SCIENCE to all members of the Association for the eighteen months during which the arrangement has been in effect. In order, however, that the finances of the Association may be on a satisfactory basis without depending on the initiation fees of new members, and in order that the publishers of SCIENCE may not lose by the arrangement the membership must be 4,000 and should be 5,000. We recommend that special efforts be made to increase the membership to at least 4,000 at the time of the Washington meeting.

We recommend that we be authorized to renew for the year 1903 the present contract with the Macmillan Company, according to which SCIENCE is sent to all members of the Association in good standing on the payment of $2 for each member from the funds of the Association.

Professor Simon Newcomb, the chairman of this committee, is abroad, but it is known that he concurs in its recommendations.

(Signed.)

CHARLES S. MINOT,
G. K. GILBERT,
R. S. WOODWARD,
J. McK. CATTELL,
L. O. HOWARD.

The general proceedings of the Association inclusive of action by the council of general interest, but which did not come before the general sessions, are as follows:

The first general session was held in Music Hall, Carnegie Institute, on Monday, June 30, at 10 A.M. with the retiring president, Dr. C. S. Minot, in the chair. After a prayer offered by the Rev. Lemuel Call Barnes, D.D., the retiring president, Dr. Charles S. Minot, of the Harvard Medical School, introduced the president-elect Professor Asaph Hall, U. S. N., who called on Dr. W. J. Holland, director of the Carnegie Institution and chairman of the local committee. Colonel Samuel H. Church and Colonel George H. Anderson also welcomed the Association to Pittsburgh, and President Hall made a brief reply.

A lecture on 'The Prevention of the Pollution of Streams by Modern Methods of Sewage Treatment' by Dr. Leonard P. Kinnicutt, was given in the Music Hall, Carnegie Institute on Monday evening, June 30, and the address of the retiring president, Dr. C. S. Minot, was delivered in the same place on the following evening. Dr. Minot's lecture 'The Problem of Consciousness in its Biological Aspects' was printed in full in the last issue of this Journal. Mr. Robert T. Hill, of the U. S. Geological Survey, gave an illustrated lecture on 'The Recent Disaster in Martinique' in the same place on Thursday evening, July 3, which formed the concluding exercise of the meeting.

In order to facilitate business and shorten the period of necessary attendance of certain members of the council, it was voted by that body that its duties be delegated to an executive committee consisting of the secretaries of the Association and the secretaries of the several sections for the session of the Saturday preceding the week of the meeting in which the program is offered.

The permanent secretary was instructed to express to the secretary of the Smithsonian Institution the appreciation of the Association for his services to science in providing for a table at the Naples Biological Station.

The Washington committee on the election of new members during the interim of council meetings was continued with power.

A message of sympathy was sent to King Edward of England.

Reports by Alexander Macfarlane on quaternions, and by H. B. Newsom on the theory of collineations to Section A, were ordered printed in full in the proceedings. The following resolutions on the American International Archeological Commission, recommended by Section H, were approved and adopted by the Council and ordered printed:

WHEREAS, The Second International American Conference, commonly known as the Pan-American Congress, in session duly assembled in the City of Mexico January 29, 1902, adopted a recommendation to the several American nations participating in the Conference, that an 'American International Archeological Commission' be created;

WHEREAS, The recommendation has been transmitted by the President of the United States to the Congress (Senate Document No. 330 of the 57th Congress, 1st Session), thereby giving the project official status in the United States; and,

WHEREAS, The recommendation is in full accord with the spirit and objects of American science while international agreement in laws relating to antiquities is desirable; therefore,

Resolved, That the American Association for the Advancement of Science heartily concurs in the recommendation of the Second International American Conference.

Resolved Further, That the secretary of the Association send a copy of this Resolution to the Director of the Bureau of American Republics, as an expression of the judgment of the Association.

Adopted by Section H on this July 2, 1902, and recommended to the council for adoption on behalf of the Association.

STEWART CULIN,
Chairman,
HARLAN I. SMITH,
Secretary.

Reports of Standing Committees were presented and ordered printed as below:

Twentieth Annual Report of the committee on Indexing Chemical Literature (will be printed hereafter).

REPORT OF THE COMMITTEE ON THE TEACHING OF ANTHROPOLOGY IN AMERICA.

To the Council of the A. A. A. S.: The Committee on the Teaching of Anthropology in America beg to report a continuation of correspondence and conferences in the interests of Anthropological teaching. Some of the results of the correspondence are incorporated in a paper by one of the committee (Dr. MacCurdy) entitled 'The Teaching of Anthropology in the United States' published in SCIENCE, January, 1902. During the year a course of lectures was delivered by one of the Committee (the Chairman) in the Free Museum attached to the University of Pennsylvania, pursuant to the purposes of the Committee.

The expenses of the Committee have been inconsiderable and no appropriation was asked. It is recommended that the Committee be continued.

W J MCGEE,
FRANZ BOAS,
W. H. HOLMES.

REPORT OF THE COMMITTEE ON ANTHROPOMETRY.

Anthropometric researches under the auspices of this committee have been continued during the year. Professors Cattell and Boas, members of the committee, and Professors Thorndike and Farrand, fellows of the Association, have during the year made measurements of students entering and graduating from Columbia College, and have made other studies on individual differences. Professor Thorndike has investigated especially the correlation of traits in school children. Mr. Farrington has studied the question as to whether brothers who have attended Columbia University are more alike than those who are not brothers. Mr. Bair and Dr. Wissler are calculating the results of measurements of school children made by Professor Boas. Professor Cattell is collecting data on individual differences, in which 1,000 students of Columbia University, 1,000 of the most eminent men in history and 1,000 scientific men of the United States are being considered.

Progress has been made with the construction of a travelling set of anthropometric instruments, toward which an appropriation of $50 was made at the Denver meeting of the Association. It is believed that the model of a portable set of instruments would be of value for work in schools, for the study of primitive races, etc. The present set is the property of the Association and is to be used in the first instance in making physical and mental measurements of members. Such measurements were begun at the New York meeting, but they cannot be continued until a portable set of instruments is available and arrangements are made for assistance in carrying out the meas

urements. The instruments will be ready at the time of the Washington meeting, and an assistant could probably be secured to take the measurements if his travelling expenses were paid. We should be pleased if an appropriation to this committee of $25 or $50 could be made for this purpose. An appropriation was made for a series of years by the British Association for its anthropometric laboratory. Our own measurements are more extended than those of the British Association, especially in the direction of mental traits; but it would be interesting to compare the measurements of the members of the British Association with similar measurements of American men of science.

J. McK. Cattell,
W J McGee,
Franz Boas.

COMMITTEE ON THE STUDY OF BLIND INVERTEBRATES.

To the Council of the A. A. A. S.: Gentlemen—In behalf of your Committee on the Investigation of Cave Animals, I beg leave to report that the following publications have recently been issued, or will appear before the Washington meeting, in January:

1. An account of the arthropods of the caves of Texas by Carl Jost Ulrich, *Proc. Am. Micr. Society*.

2. An account of the history of the eye of amblyopsis from its appearance to death of the individual by old age.

3. The eyes of Rhineura, *Proc. Washington Acad. Sci.*

During March of the present year, the writer, accompanied by Mr. Oscar Riddle as assistant and interpreter, visited the blind fish caves of western Cuba. A general account of the trip was presented before Section F. The crustacea collected will be described by Mr. W. P. Hay. The eyes of the blind crustaceans and the eyes of the blind fishes, blind lizards, and blind snakes collected will be described by my students and myself.

The expenses of the Cuban trip, amounting to about $400, have been met in part by an unexpended balance of about $80 from the $150 heretofore granted by the A. A. A. S., a promise of $85 for a report on the fishes by the U. S. Fish Commission, and from the sale of specimens. In behalf of the Committee I respectfully request that the Committee be continued and that a grant of $100 be made to continue the work.

In the absence of the other members of the Committee respectfully submitted by

Carl H. Eigenmann,
Secretary.

REPORT OF THE COMMITTEE ON THE RELATIONS OF PLANTS TO CLIMATE.

To the Members of the Council: Gentlemen—The efforts of the Committee have been directed to the development of methods which would secure continuous records of the temperature of the soil, and which would make possible an analysis of the comparative influence of the widely different soil and air temperatures upon the general development, physiology and distribution of plants. The Committee has been so fortunate as to secure the cooperation and interest of Professor Wm. Hallock, of Columbia University, and a thermograph designed by him has been constructed and installed for taking continuous records of soil temperatures. (For description, see *Journal New York Bot. Garden*, July, 1902.) With the invention of this instrument, the Committee now finds itself in a position to study some of the main problems confronting it with much promise of success in the way of valuable results, and asks a further grant of sixty-five dollars to enable it to construct and maintain two additional instruments, and to make other necessary records and experiments. In the absence of the other members of the Committee, Messrs. Trelease and Coulter, this report is submitted with their general approval, and with the unanimous approval of Section G.

Respectfully,
D. T. MacDougal.

Report of the Committee on the Atomic Weight of Thorium. (Will be printed hereafter.)

The following grants were made for the ensuing year:

To the committee on anthropometric measurements..........	$50.00
To the committee on the investigation of blind invertebrates..	75.00
To the committee on the atomic weight of thorium...........	50.00
To the committee on the relations of plants to climate..........	75.00

By the action of the Council on July 3, 1902, a new committee consisting of W. S. Franklin, D. B. Brace and E. F. Nichols was appointed to which was entrusted in-

vestigations of the velocity of light, and a grant of $75.00 was made to this committee.

The following members were elected fellows at the sessions of the Council on July 2 and 3, 1902:

Abbott, Charles G., Smithsonian Inst., Washington, D. C.
Abel, John, Jr., Baltimore, Md.
Bain, Samuel M., Knoxville, Tenn.
Ball, Carleton R., Washington, D. C.
Blackmar, Frank Wilson, Lawrence, Kansas.
Caldwell, Otis W., Charleston, Ill.
Chamberlain, Chas. Joseph, Chicago.
Cook, Melville T., Greencastle, Ind.
Coquillett, D. W., Washington, D. C.
Duncan, G. M., New Haven, Conn.
Dunn, Louise B., Barnard College, N. Y. City.
Farrand, Livingston, New York.
Fisher, Irving, New Haven, Conn.
Fletcher, Robt., Hanover, N. H.
Gifford, John C., Ithaca, N. Y.
Goodyear, Wm. H., Brooklyn, N. Y.
Gould, G. M., Phila., Pa.
Grant, U. S., Evanston, Ill.
Gregory, H. E., New Haven, Conn.
Hazen, Tracy E., New York.
Herrmann, Richard, Dubuque, Ia.
Herter, C. A., New York.
Humphrey, Richard L., Phila., Pa.
Jenks, Albert E., Bureau Amer. Ethnology, Washington, D. C.
Jordan, Whitman H., Geneva, New York.
Kearney, Thos. H., Washington, D. C.
Lane, A. C., Lansing, Mich.
Lovett, Edgar Odell, Princeton, N. J.
Luquer, Lea McI., Columbia Univ., New York.
McGuire, Jos. D., Washington, D. C.
McNair, F. W., Houghton, Mich.
Mathews, John A., 4 First Place, Brooklyn, N. Y.
Mills, Wm. C., Ohio State Univ., Columbus, O.
Moseley, Edwin L., Sandusky, O.
Moses, A. J., Columbia Univ., N. Y. City.
Osler, W., Baltimore, Md.
Owen, Charles Lorin, Field Columbian Museum.
Paton, Stewart, Baltimore, Md.
Penfield, S. L., New Haven, Conn.
Piersol, G. A., Phila., Pa.
Powers, LeGrand (Tufts), Washington, D. C.
Pratt, Jos. Hyde, Chapel Hill, N. C.
Richards, Herbert Maule, New York.
Sanford, E. C., Worcester, Mass.
Savage, W. L., New York.
Schlesinger, Frank, Ukiah, Cal.
Schmeckebier, Lawrence F., Washington, D. C.
Schwatt, Isaac Joachim, Philadelphia, Pa.
Seashore, C. E., Iowa City, Ia.
Shattuck, Samuel Walker, Champaign, Ill.
Shaw, Walter R., Stillwater, Oklahoma.
Skinner, Henry, Phila., Pa.
Slichter, Charles S., Madison, Wis.
Small, John K., Bedford Park, N. Y. City.
Sneath, E. H., New Haven, Conn.
Spalding, Volney M., Ann Arbor, Mich.
Stanton, T. W., U. S. Nat'l Museum, Washington, D. C.
Stone, Geo. E., Amherst, Mass.
Tatlock, John, Jr., New York City.
Taylor, E. W., Boston, Mass.
Thompson, Alton H., 721 Kansas Ave., Topeka, Kansas.
Thompson, N. Gilman, New York.
Titchener, E. B., Ithaca, N. Y.
Tooker, Wm. Wallace, Sag Harbor, N. Y.
Towle, Wm. Mason, Syracuse, N. Y.
Townsend, Chas. O., Washington, D. C.
Tucker, Rich'd Hawley, Mt. Hamilton, Cal.
Updegraff, Milton, Washington, D. C.
Ward, Robt. DeC., Cambridge, Mass.
Wilder, B. G., Ithaca, N. Y.
Williston, S. W., Univ. of Chicago.
Wood, T. D., New York.
Woods, F. A., Boston, Mass.

As a result of action taken by the Council, Section D and the general session on July 3, 1902, Mr. George Westinghouse was elected an honorary fellow of the Association.

The following report by the Permanent Secretary was received and adopted:

FINANCIAL REPORT OF THE PERMANENT SECRETARY JANUARY 1 TO DECEMBER 31, 1901.

Debit.

To Balance from last account	$4,741.46	
Admission fees 1900	15.00	
Admission fees for 1901	5,765.00	
Annual dues for 1902	5,034.00	
Annual dues for 1901	7,874.00	
Annual dues for previous years	774.00	
Associate fees	123.00	
Fellowship fees	398.00	
Life membership fees	1,050.00	
Publications	68.29	
Binding	23.66	
Interest	38.20	
Miscellaneous receipts	210.44	
		$26,115.05

Credit.

By publications..............$6,548.07
By expenses Denver meeting.. 739.16
By expenses in propagandist work 1,819.90
By general office expenses.... 635.09
By salaries.................... 2,000.00
By miscellaneous disbursements* 2,087.00
By balance to new account...12,285.83
$26,115.05

I hereby certify that I have examined this account and that it is correctly cast and properly vouched for, and that the balance was on deposit in Washington banks as follows: Citizens' National Bank (January 2, 1902), $9,955.62; National Safe Deposit and Trust Co. (including interest credited, January 1), $1,274.85; American Security and Trust Co. (including interest credited January 6), $1,055.36; in all, $12,285.83.

G. K. Gilbert,
Auditor.

The following report by the Treasurer was received and adopted:

REPORT OF THE TREASURER.

In compliance with Article 15 of the Constitution, and by direction of the Council, I have the honor to submit the following report, showing receipts, disbursements, and disposition of funds of the Association for the year ending December 31, 1901.

Receipts have come into the keeping of the Treasurer from three sources, namely: First, from commutations of annual fees of life members of the Association; secondly, from excess of receipts over expenditures of the Permanent Secretary; and, thirdly, from interests on funds deposited in savings banks. The aggregate of these receipts is $2,397.89.

Disbursements made in accordance with the direction of the Council amount to $460.00.

The total amount of funds of the Association deposited in banks and subject to the order of the Treasurer, December 31, 1901, is $12,127.07.

The details of receipts, disbursements, and disposition of funds are shown in the following itemized statement.

Dated June 1, 1902.

* This includes $2,050 turned over to the Treasurer to be added to the permanent funds of the Association.

THE TREASURER IN ACCOUNT WITH THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Dr.

1901.
To balance from last account.$10,189.18
Dec. 7, to amount transferred from funds of permanent Secretary 1,000.00
Dec. 14, to amount received for 21 life memberships 1,050.00
Dec. 31, to amount received as interest on funds deposited in Savings Bank as follows:
From Cambridge Savings Bank, Cambridge, Mass.......$36.96
From Emigrant Industrial Savings Bank, New York, N. Y...102.08
From Institution for the Savings of Merchants' Clerks, New York, N. Y........ 99.50
From Metropolitan Savings Bank, New York, N. Y........109.35
——— 347.89

Total $12,587.07

THE TREASURER IN ACCOUNT WITH THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Cr.

1901.
Apr. 30, by amount paid to permanent Secretary from contribution of Mrs. Phoebe Thorne to New York Committee...... $200.00
Aug. 29, by cash paid D. T. MacDougal of committee on study of relations of plants to climate. 60.00
Aug. 29, by cash paid Jas. McK. Cattell of committee on anthropometric investigations..... 50.00
Oct. 4, by cash paid Charles B. Davenport of committee on the study of biological variations 100.00
Nov. 11, by cash paid Charles Baskerville of committee on the study of the atomic weight of thorium................ 50.00
Nov. 31, by cash on deposit in banks as follows:

In Cambridge Savings Bank, Cambridge, Mass.	$1,084.32	
In Immigrant Industrial Savings Bank, New York, N. Y.	2,882.93	
In Institution for the Savings of Merchants' Clerks, New York, N. Y.	2,918.47	
In Metropolitan Savings Bank, New York, N. Y.	2,999.15	
In The Fifth Avenue Bank, New York, N. Y.	2,242.20	
		12,127.07
Total		$12,587.07

I have examined the foregoing account and certify that it is correctly cast and properly vouched.

EMORY MCCLINTOCK,
Auditor.

June 23, 1902.

The chief feature of the closing session of the Association in the Music Hall of the Carnegie Institute on Thursday evening, July 3, was an illustrated lecture by Mr. Robert T. Hill on the recent volcanic eruptions in Martinique, in which the chief features of his recent investigations were described. After the lecture a series of resolutions were passed expressing the thanks of the Association to the various persons and organizations in Pittsburgh concerned in the organization of the meetings and entertainment of the members.

D. T. MACDOUGAL,
General Secretary, A. A. A. S.

NEW YORK, July 5, 1902.

*APPLIED BOTANY, RETROSPECTIVE AND PROSPECTIVE.**

IT has been the general practice in past years for the retiring Vice-President of this Section to give a summary of the results accomplished in research work, and to point out the lines along which there appears promise of further advancement. The facts set forth in these addresses and the opportunities pointed out in them have proved of great advantage to all, especially the younger men, who draw their inspiration from what has been accomplished in the past and what the future holds forth. In choosing my subject, I have deviated somewhat from the usual practice heretofore followed, not because I have anything particularly new to say or any particularly startling facts to disclose, but rather for the reason that it seems desirable at this time to emphasize some of the things that appeal to us as possibly having a marked influence on the future development of botanical work. To one who is necessarily thrown in contact with the somewhat hurly-burly affairs of life, the old meaning of botanical work is gradually giving way to something else—something that reaches out into practical affairs and pushes its way into paths where, a few years ago, the botanist would have feared to tread.

Now the question arises, is botanical science to suffer by this movement, or is it, after the first preliminary efforts, to emerge rehabilitated, stronger and more vital than ever before? I have neither fear nor doubt as to the outcome, and believe that the spirit which has made us commercially a leader of nations will enable us to build up a science which neither time nor change can seriously affect. It hardly needs any extended statement to call to mind the rapid changes which have taken place in botanical work and botanical thought during the past twenty years, yet a critical study of these changes is, to me, one of the most hopeful signs that our progress has constantly been in the direction of a stronger place in the world's usefulness and a higher plane of scientific thought. Twenty

* Vice-presidential address before the Section of Botany, American Association for the Advancement of Science. Pittsburgh meeting, June 28 to July 3, 1902.

years ago the botany taught in our universities and colleges was of such a nature as to meet the general requirements of the time. It broadened out rapidly during the last ten years of this period, but it was still limited in large part to systematic studies, with some few attempts here and there to enter the field of morphology, physiology, and the kindred branches. Perhaps no one thing has given a greater stimulus to applied botany than the organization of the various State Experiment Stations, under what is known as the Hatch Act, which became a law in 1886 and went into active operation a year later. Under the broad authority given in this Act, establishing a Station in each State and Territory, opportunities were afforded for advanced studies of both plants and animals in their bearing on agricultural development, and as a result there was an extraordinary demand for men, which, even yet, it is impossible to meet.

Coincident with the establishment of the Experiment Stations came a broadening of the work of the National Department of Agriculture, thus creating the need for still more men trained in certain lines. At this time the era of specialization was scarcely upon us, but such was the demand for men and work that the stimulus to those engaged in special lines was great.

Of course, this country was not alone in the movement which has just been described, for in Europe, and particularly in France, there was experienced the same need for help in applied lines, and as a result extraordinary efforts were put forth by those in charge of chairs in the various institutions of learning to meet these demands. The happenings such as we are describing are met with frequently in the progress of the world, and are really the culmination of more or less subjective thought, which, when the proper moment arrives, breaks into force and makes itself felt in an objective way. It is found, therefore, that while this work was making rapid strides, the demand was so great for immediate practical results that sufficient attention was not always given to that accuracy and precision of conclusion that the world's best thought demands. There was a proneness, in other words, to sacrifice accuracy to utility. Helmholtz, long ago, sounded a warning on this subject, when he said that 'Whoever in the pursuit of science seeks after immediate practical utility may generally rest assured that he will seek in vain.' On the other hand, there is a class of investigators, and their numbers are considerable, whose work, for the most part, is largely ahead of the practical side. Possibly, taking all of the work that has been done in this country, the need is not so much for more research, but for the practical application of the researches already made to the everyday affairs of life. In some branches this, of course, has not been the case, as is evidenced by what has been accomplished in a number of important fields during the past fifteen years.

Of the different branches of botanical science that have been applied to the betterment of man, physiology and pathology stand preeminently to the front. We cannot lay any great claim to much in the way of studies in the pure science of physiology, but the practical application of these studies to the affairs of life has been considerable.

In passing, I may be pardoned for emphasizing somewhat in detail a fact that seems to be little appreciated, and that is the great value and usefulness of the individual or organization that can bring to the attention of the people the results of scientific work in such a way that mankind as a whole is bettered, and the struggle for life is made less a burden. What value to the world is a scientific discovery unless it is clothed by some gen-

ius with a force that will bring its usefulness home to thousands, where before it would have been known to but a few of the elect? While willing to admit that America, for very good reasons, has not as yet been able to take front rank in the way of original discoveries, no one will deny the fact that our country has quickly turned to practical account discoveries of all kinds where there was promise of practical results. So that while in physiology, laboratory investigations have been pushed with vigor abroad, our efforts have been, in the past, mainly in the direction of broad field work, which has added materially to the wealth and power of the country. This is particularly the case with the work on legumes and the application of laboratory discoveries to the problems connected with nitrogen supply and the rotation of crops. The extended work of Laws and Gilbert, and other experimenters, has done much to emphasize the value of the broad application of laboratory research in this field. It sometimes happens in work of this kind that its application is of such a special nature as to preclude a proper appreciation of its value in a general way. Such, for example, is the work of Löew, who three years ago undertook a very special problem having to do with the handling of tobacco, and which, in two years, was practically finished, but so changed the aspect of the work that it opened great possibilities in building up an important industry and adding wealth to the country as well. The keen competition in tobacco growing, and the fact that the finest grades were, in large part, imported, made it very desirable and important that all available information in regard to the crop be secured. The chief problem upon which light was needed had to do with the fermentation of the leaf. Prior to Löew's work, it was generally held that fermentation was, in large part, due to bacteria, and that the difference in the aromas of tobacco might, to a certain degree, be controlled through the action of these organisms. Löew's work showed that the fermentation of tobacco was due to enzyms. The enzyms causing the fermentation were isolated and methods for controlling them were pointed out. As a result of this work improved methods of handling the crop have been developed and new industries established. Such, for example, is the Sumatra tobacco industry developed in Connecticut, which owes its incentive to the advanced work of Löew, and which bids fair to add a great deal to the material wealth of the country.

Plant breeding is another branch of applied work closely related to physiology, which has made rapid advances during the past few years. It is true that plant breeding leads off into horticultural and other fields, but the advances that have been made in this field in recent years have had their inception largely in botanical studies. The work, as a whole, has had for its object the advancement of industrial pursuits, and has aided materially in adding to the wealth and progress of the country. It is true that in some cases applied work in this line has been pushed in advance of scientific research, but this has led to no serious results, for notwithstanding a lack of knowledge as to the full scientific significance of the various operations performed, the results have in most cases shown far-reaching intuitive knowledge on the part of those who have actually been engaged upon the various problems. What has been accomplished by Bailey, Webber, Waugh, Burbank, Hayes and others has shown great possibilities, and the improvement made in many crops will, no doubt, in time, prove of more value than even the present seems to indicate.

In no branch of botanical science have the advances in applied work been more pronounced than in pathology. Twenty

years ago plant pathology was practically unknown in this country. Little or no attempt had been made toward systematic work in this field, and what had been accomplished was largely in the direction of applying information secured as a result of investigations abroad. The first attempts in the study of pathological problems were naturally confined to questions having to do with parasites. The effects of parasitic enemies of plants were pronounced and gave opportunity for the most ready investigation. In looking back, therefore, on the early development of the work, it is not strange to find that investigations, for the most part, were in the direction of economic mycology, for it was largely a study of parasitic fungi in their relation to plant diseases. The important problems connected with the relation of the fungus to the host and host to fungus were, for the most part, overlooked. Pathology, therefore, had its inception largely in mycological investigations, which later developed into a study of the host itself. This naturally led into the field of plant physiology and developed slowly the important work of investigating plant environment and its relation to pathological phenomena. It was early seen that no sharp line of distinction could be drawn between any of these various branches, and for this reason it became important to push the investigations along several different lines. To the early workers in this field is due the credit of laying the foundation which paved the way for a full understanding of the broad problems elucidated later, and as a result the science itself has been established on a firm basis.

It is the practical application of this science, however, that has attracted such widespread attention everywhere, especially the work which has been done in this country and in France. Prior to 1885 very little was known in regard to the treatment of plant diseases. The discovery of the efficacy of certain compounds in the treatment of crop diseases about this time led to a rapid awakening of the importance of the subject, and for the next few years there was a phenomenal advancement in the field treatment of plant maladies. Improvements in laboratory methods also did much to stimulate advanced work, and made possible lines of research which were not practicable before the discovery of such methods. What has been accomplished in this field alone has done much to encourage applied work and show the importance of such work as an aid to the advancement of pure science.

It has become the practice of late to ignore the important part that systematic botany has played in making known the practical value of plants to the human race. In the rage for special problems the fact is often overlooked that many of them owe their inception to prior efforts in taxonomic lines. It is hardly necessary or essential to go into details upon the bearing of systematic botany to applied work; but in passing, attention should be called to the great benefit that has come to the country as a whole through the important work on grasses, forestry and medicine. Some of the earliest work in economic lines in this country was based primarily on the systematic study of grasses, the object being to determine their agricultural value. The early investigations of Vasey did much to call attention to the value of applied botany, and there has been developed from this work very important and far reaching lines of research, such as are now being carried on by the U. S. Department of Agriculture and many of the experiment stations. This work, while having for its basis systematic studies, extends into broad fields of agronomy and other lines, such as have to do with the improvement of pastures or range lands, and many other similar lines. The

same is true of many of the important investigations that have been carried on in the matter of studying noxious plants, as, for example, weeds, etc.

The advanced forestry work of the present also owes its inception, primarily, to systematic studies which were begun years ago, and which are still continued in order to form an intelligent and rational basis for many of the advanced problems in this field.

In medicine, too, the study of systematic botany has played an important part. It was the general practice in the early days for physicians to be trained in botanical lines, and a great deal of our most important information has been brought out by the work of these same physicians. In fact, it has generally been considered necessary for physicians to be pretty thoroughly posted on botanical matters; hence the close relationship of botany to the practice of medicine has always been recognized. With systematic botany as a basis, the study of materia medica has advanced rapidly and has formed an important item in the development of our work. The differentiation of pharmacy from medicine has also led to further advancement in these lines, and has done much to advance the value of the investigations.

Probably in no other field of botanical science has the applied work been of more value to mankind than in bacteriology, surgery and sanitation. The systematic study of the causes of disease has led to most valuable results, and in nearly all of these investigations the inception of the work can be traced to one or more lines of botanical science. Such, in brief, have been some of the advances in applied botany in this country, and with this somewhat hasty sketch in mind, let us turn our attention to the future and consider what opportunities are before us, and along what lines our efforts should be put forth in order to achieve the highest and best results.

Attention has already been called to the importance and necessity of constantly keeping in mind the fact that in the application of science we cannot be too careful as to the foundation of our work. In the race for results we are too apt to lose sight of this fact, and in the end we find, too late, that our entire fabric has been built of straw, and tumbles to earth at the first gust of wind. It is necessary, therefore, in looking to the future development of applied work in this country, that we should turn our attention, not so much to the older men who are already in the field, but to the younger generation, who are still to come up; and the training they are getting, or are to get, in the various institutions of learning throughout the country. It is too true that many of our institutions of learning have been slow to recognize applied science; and even now, with all the demand for applied work, little or no effort is being made to put this work on the basis where it belongs. The training in applied lines at this time is meeting with much the same opposition that science itself did when first introduced into our colleges—especially science as taught by laboratory methods, rather than science as taught by handing down from year to year doubtful knowledge long stored in dusty tomes. There was a time, and not so far distant, either, when to be a student in a science course in some of our institutions required considerable moral stamina; but all this is changed with respect to science; yet there still lingers that inherent hostility to all things practical, as is most strikingly emphasized in institutions where applied work, such as agriculture, engineering, etc., is made a part of the regular course. With the great increase of wealth in this country and the commendable spirit being manifested in the endowment and establishment of institutions of learning, the fact must

not be lost sight of that there may be some danger, as has been pointed out, in building up an 'educated proletariat,' a class who, as specialists, will care more for getting their names attached to abstruse technical brochures than they will for a treatise that will enable some struggling mortal to make life less a burden. Some one has truly said that the danger from education is not so much from its quantity as from its character, so that it is the character of our training that should receive most careful, conscientious and considerate thought.

This leads us now to a consideration of the nature of the training our young men should receive in order to fit them more especially for the opening fields of labor in applied botany, and at the same time make good citizens of them, whether they go into the work in question or some other equally important. Pure science, of course, must form the groundwork for this training, but in addition to that there should be parallel with it, throughout the entire course, a rigid system of training in the application of science to the practical affairs of life. It is needless to say that we do not have anywhere in this country, at the present time, such a course of training in botany; and for this reason the men who go into this kind of work must receive their training, in large part, after the college doors close on them. I do not wish to be understood as implying that this state of affairs is due to our teachers, for most of them recognize the fact just mentioned and are doing everything in their power to overcome it. The trouble is with our system of education as a whole, but more directly the body politic, which has, ever since mind training began, given preference to the ornamental rather than the useful. Nothing has done so much to weaken this idea in the human mind as science itself, and nothing can so strengthen science in what it can further do in this direction as to teach its broad practical application to the affairs of life. It would seem, therefore, that the time is ripe for some decided action leading to a clearer understanding as to the methods whereby the increasing demand for men trained in applied botanical work may be met. The National Government alone is spending close on to a million dollars a year in this work, and the demand for the right kind of men far exceeds the supply. In fact, the Government, through lack of properly trained men, has been forced to undertake the training itself, a course which would not be necessary if the proper cooperation could be secured from the colleges. Here is a subject which might very properly be taken up by this Association, and more especially this Section, as it is one in which most of us are either directly or indirectly interested. I have dwelt upon it somewhat in detail, as it has seemed to me the foundation upon which all other matters are built. With the men that we have and the men we can get, what then are some of the problems with which applied botany in the future can hope to deal?

With the opening of new territory during the past few years there has of course developed a need for still broader work, for we are now especially pressed for tropical investigations, which we are unable to meet through lack of equipment and lack of properly trained men. Moreover, another and equally important field has been opened through the rapid extension of our population into the arid and semiarid regions; and the demand from these people for light on many subjects, which we are ill prepared to give. It seems to me that everything points to the fact that the heavy demands for applied botanical work for the next fifty years will be mainly in the field of plant physiology and pathology. The two subjects are intimately connected, and while there will, of course, be many physi-

ological problems pure and simple, somewhere and at some time these problems will be found closely associated with pathological phenomena.

Reverting to our Western conditions, arid and semiarid, there are many questions which demand immediate attention and which have an important bearing on the future development of the country. Such, for example, are those which have to do with the water supply of plants and the bearing of water supply on plant production. Irrigation is now an important factor in our industrial and commercial development, and the problems associated with it must be reckoned with. In the past the work in this field has been mainly of an engineering nature, such as the question of securing water and bringing it as economically as possible to the plants. Now arise far more reaching questions, such as how to handle this water in a way to attain the desired maximum results with the least expenditure of time and money. Given water, soil rich in plant food and proper heat and light, the productive power of plants is great if the requisite knowledge is present as to how best to utilize what nature and art supply. Such problems as these must, for the most part, be worked out in the field, but the field must be made to take the part of a laboratory, for laboratory methods on an extensive scale must be employed.

What is the effect of varying quantities of water on the longevity of a plant; how is the production of fruit and foliage affected by the water supply; how far can time of ripening, color, keeping qualities, and resistance to diseases and insect attacks, be controlled through the ability to control the amount of water used? These problems, on their face, appear simple, but they are important ones and to throw light upon them there must be most careful studies in a number of fields. Chemistry will of course enter into these studies, but it must be a living, vital chemistry, if I may use such a term, and not the mere question of ash determinations. Closely related to the problems involved in water supply are those which have to do with so-called alkali soils, and their effects on vegetation. A question of supreme importance to the development of our western country is to know more of the effects of various mineral salts, severally and combined, on plants. With such complicated problems as present themselves to the investigator in this field, it is not safe to base any conclusions on the knowledge of how plants behave in a laboratory, where the action of a single salt or simple combination of salts has been determined. The fact that individual plants show marked differences in their ability to resist the poisonous effects of alkali salts opens up an interesting field in the matter of plant selection and plant breeding. Wherever crops are grown in alkali soils, especially under irrigation, the power of certain of these plants to make better growth and give greater yields than their nearby neighbors has been noted.

Profiting by these facts, an important field opens in the matter of developing alkali resistant plants, having the power to give relatively large yields in the presence of an unusual amount of soluble salts in the soil. Some interesting suggestions have been made in this direction by the recent work of Kearney and Cameron, and the same investigators have also pointed out the great economic advantages that may result from the combination of two or more salts which, individually, may be dangerous, but when combined have the opposite effect on plant growth.

The nature of the problems here briefly reviewed shows the broad scope of physiological investigations, for they merge at various places into ecology, pathology, chemistry and physics. There is, further-

more, shown the futility of attempting to solve such problems along one line of cleavage, for it cannot be done with any degree of satisfaction.

Aside from the problems mentioned, the field for applied work in plant nutrition is large. The physiological rôle of mineral nutrients in plants is little understood, and the effects of mineral nutrients on growth, singly and combined, should be explained. The power to control profitable plant production through a better knowledge of plant foods is recognized, but there is yet much to do in the matter of making clear little known or obscure questions on this subject. In the problems connected with the acquisition of nitrogen, however, are to be found some of the most important practical questions in this field. The results already accomplished in this direction, through the use of proper nitrifying ferments, have not been as successful as was anticipated, but this does not indicate that future work may not be made more profitable. There is much to be done in the way of investigating the life history of bacteria inhabiting the root tubercles of legumes, for unless such questions are better understood it will not be practical to apply our knowledge in any far-reaching way. The time will doubtless come, however, when our knowledge of the nitrifying organisms will be sufficient to enable us to apply, in a much broader way, the use of pure cultures of such organisms in general field work. Already encouraging results have been obtained in this direction, and steps are being taken to extend the practical application of these results as rapidly as circumstances will warrant. The future success of this work will no doubt depend, in large measure, upon the ability to properly grow the nitrifying organisms in large quantities and at an expense which will not curtail their use; and then to be able to distribute the organisms in such a way that the farmer himself may use them at little expense, but with sufficient profit to pay for his trouble. It will be seen, therefore, that while these may appear as simple problems when looking at them from the purely utilitarian view, there is much work to be done in the laboratory, under rigid scientific conditions, before satisfactory conclusions can be reached.

It is in connection with the problems bearing on plant breeding, and the selection of plants better adapted to meet the special requirements, that some of the broadest questions of applied botany can be brought to bear. While, as already explained, plant breeding is more or less of a composite science and, to a certain extent, an art, physiology is, after all, the basis for most of the work. There is much need for further research work in the field of reproduction and heredity, especially with a view to obtaining light on many practical questions which are bound to come up within the next few years if applied investigations are to have their proper place. Admitting the necessity of these, it would seem that some of the more practical problems that must be considered within the near future will have to do with obtaining light on such matters as the securing of plants adapted to particular purposes and to particular regions. As population increases and competition in all lines of agricultural production becomes keener, the need for securing plants better adapted to certain conditions and which can be produced at a minimum expense, will become greater and greater. In the South there is already felt the urgent need for improved kinds of cotton varieties that will give greater yields and finer staple, in order that cheap labor of foreign countries can be competed with. There is also a demand for improvement in other plants adapted to the South, which will en-

able the Southern agriculturist to more generally diversify crops.

We have been told at former meetings of this Association, by members of other Sections, that within a comparatively short time the United States will not be able to grow the amount of wheat, and possibly other cereals, needed for consumption. These statements are based on our present yields and the increasing demands of population. If the figures are true it would seem important, therefore, that attention be drawn to the securing of varieties of wheat better adapted to existing conditions and yielding larger quantities of grain. This is a perfectly legitimate field for applied botanical work, and what has been accomplished already indicates that much can be done in the direction of largely increasing the possibilities of this country in the matter of cereal production. What is true of cotton and cereals is also true of many other crops, so that it is unnecessary to go into detail as to what might be accomplished in the way of causing not only an increased output, but improving the quality of the output as well.

Associated with the work of plant breeding, and more or less closely related to it, is another important field which has for its object the studies of life histories of principal crop plants, with a view of determining the environmental conditions necessary for successful growth. This work, of course, covers a broad field, as it involves knowledge of the requirements of climate and soil, and really merges into the broader territory of ecological work. The problems involved carry with them, not only the question of plant adaptations, but the matter of introducing new plants from foreign countries and the broader dissemination of plants already existing here and which give promise of more profitable yields under changed conditions of environment. With proper studies of soil and climate, the possibility of more intelligently defining the areas adapted to certain crops will become greater. After all, however, the vital questions involved in this problem will depend largely upon actual experimentation, as those most familiar with successful crop production know how unsafe it is to generalize in such matters. The success or failure in growing a certain crop often depends on differences in soil and climate so slight that present instruments cannot determine them, although the plant, with its power to respond to unmeasurable stimuli, can do so.

In the field of pathology the opportunities for applied work in the near future will be great. We are all agreed that the more or less empirical methods of handling plant diseases has about reached an end. It served a useful purpose in pointing out practical ways of controlling some of the common and destructive plant maladies, and enabled those who were looking to the future to create a sentiment making possible better and more far-reaching work. We do not agree with those, however, who hold that the time is at hand when we can afford to stop the propaganda of actual field treatment. In fact, we are more and more convinced that one of the greatest opportunities for bringing home the practical value of pathological studies will be to undertake at once, on an extensive scale, what may be called demonstration experiments. A propaganda in this field, conducted by and depending upon publications alone, no matter how practical such publications are, will necessarily be slow; but when the work can be carried into the field and be made to serve as an object lesson, the impression made is lasting and convincing.

One of the problems, therefore, for the future, in this work, is how to insure the application of the investigations made and to so conduct the work that it will all go

toward the development of a system of plant pathology which will build up and strengthen the science. Recognizing the importance and necessity for the application of remedial measures in the form of fungicides, to which the foregoing remarks mainly apply, we may turn our attention from this art, for so it is, to other methods of applied work in this particular field of botany. The future of other lines of applied work all hinges on a recognition of the possibilities within the plant itself, its plasticity and ability to change, the effects of environment and the means of controlling environment or controlling the plant to meet the requirements of environment, to the end of securing desired results. Here again the breeding of plants will enter and furnish the means of overcoming diseases by selection of resistant varieties from those already existing and the creation of new varieties having the desired characteristics. Here, too, arises the question as to what factors govern resistance to disease, and how these factors may be determined and controlled. Why is it that the most successful production of a plant is often reached when its ability to resist the attacks of organisms or to succumb to functional disorders, is at a minimum, or, expressing it in a somewhat paradoxical way, why is a plant weakest when it is apparently most vigorous?

Proper knowledge on many of the problems involved in the questions here presented will make it possible to apply it in securing crops at far less risk than at present, and will tend to make the occupation of plant growing less a matter of guesswork than it is now. No rational system of pathology can be developed, furthermore, without due attention to proper field hygiene, the rotation of crops, and other similar means of surrounding the plants with healthful conditions. Some of the principal lines of work, therefore, in the future, in this field, will be in the direction of giving a broader application to existing knowledge on the question of treating plant diseases by means of fungicides, to the development of new forms better able to resist diseases and suitable for special conditions, to the handling of plants so as to better adapt them to conditions at the present, and to the improvement of field methods to the end of securing vigorous growth by furnishing conditions needful to the highest production of the crop.

Of the future problems in other lines of applied botany, it is not necessary to speak in detail. Suffice it to say, that in the broad field of forestry, agrostology and pharmacology, systematic botany will always play an important part. In agrostology, especially, which has now come to be understood as covering the study of not only the true grasses, but all forage crops as well, the field for applied work is exceedingly broad. With the rapid settlement of the East and the utilization of our arable Western lands for crops, the areas for the maintenance of stock is becoming less and less. Thus is developed the necessity for a better understanding of methods of improving and maintaining our pastures. The production of larger quantities of forage from given areas and the improvement of our range lands to the end of enabling them to support an increasing number of cattle, are some of the other important problems in this field. These broad questions will, of course, involve to a certain extent systematic studies of native floras, the changes which may result from the shifting of plants from one place to another, and the opportunities that may arise from the introduction of new forms and the improvement of those already present.

Within the last few years it is fortunate that a well-defined forest policy has been developed, so that in the future the growth of this work will be largely in a distinct

field. Botanical investigations, however, will always play a more or less important part in all matters pertaining to the subject, especially systematic studies of the tree floras and the application of these studies to questions having to do with reforestation and the protection of existing forest areas. The applied botanical work, in connection with future problems in pharmacology, will be considerable. Systematic studies of plants used in pharmacy, the introduction and cultivation of such plants with a view to increasing their usefulness, all come within this scope of applied botanical research. The study of tropical plants, which has already been referred to, is also bound to play an important part in the near future in the matter of the development of our insular possessions. As yet, we have very little satisfactory information as to the possibilities of tropical agriculture, especially as concerns our own country; and it would seem that some of the first problems will have to do with systematic studies of the field to determine existing possibilities, with a view to applying them in the near future in a practical way. There are numerous practical questions having an important bearing on all tropical work, which must receive attention before any final conclusions can be reached in regard to the successful growing of crops in these regions. These questions have to do with the interrelation of the plants themselves to the development of the existing system of tropical agriculture, so that really a systematic study of our tropical floras would seem one of the first requisites offering a key to the future solution of other and more general problems.

Bacteriology, in its relation to surgery and sanitation, has passed out of the field of applied botany, but problems will still arise. Systematic studies of the bacteria may be essential to the successful prosecution of certain phases of this work. It is hardly necessary to refer to these questions in detail, and I may therefore conclude this somewhat hasty and general sketch of the possibilities of applied botanical work, as we see them, by again calling attention to a fact which becomes more and more evident as we look into work of this nature, and that is, how thoroughly we are all dependent on others for aid, not only in our own field of science, but other fields as well. Like our social fabric, science for science's sake and applied science are becoming more and more a delicately complicated system, capable of endless harmonious expansion if viewed aright, but leading to possible endless discord if handled wrong. How essential, therefore, that the broadest spirit of tolerance should be cultivated, for no matter how small or how humble a piece of real work is, somewhere and some time it may be made to form a part of an harmonious whole. While this is a practical age, and while the demand is heavy for practical results, we should not forget that there are ages to come after us—ages that may demand something different from what the majority of us are producing now; and for this reason the laborer in some obscure field should not be forgotten, for it perhaps may be that his work, now little known or understood, may in the future take its place in the building up of mankind.

B. T. GALLOWAY.

U. S. DEPARTMENT OF AGRICULTURE.

SCIENTIFIC BOOKS.

Histoire de l'Observatoire de Paris de sa Fondation à 1793. Par C. WOLF. Paris, Gauthier-Villars. 1902. Pp. xii+392; 16 plates.

If there had come down to us from the author of the Almagest a detailed account of the home of the Alexandrian school, the dimensions and cost of its buildings, their arrange-

ment and government, the official correspondence concerning the purchase and repair of equipment, if, in short, the temple of Serapis were presented to us as Mr. Wolf has presented the Paris Observatory during the first century of its existence, the mere remoteness of Ptolemy's epoch and our comparative dearth of information concerning it, would command for his narrative of commonplace incidents an interest that is in great part lacking from the corresponding events of an epoch so much nearer to our own time.

It must be confessed that we find Mr. Wolf's chronicle somewhat dry reading, and that neither the dimensions and cost of walls and windows nor the tale of petty squabbles as to who should have the right to grow beans and onions within and beneath them, is long able to keep the reviewer's thoughts from wandering to other topics. Yet is it well that some one having access to the original sources of information should gather and arrange the data here preserved, relative to the growth of a great scientific institution, and this work Mr. Wolf appears to have done, with a praiseworthy diligence whose dry-as-dust characteristics are from time to time relieved by an entertaining digression or a touch of zeal for the house of Cassini that might well become a descendant of the three generations of astronomers so intimately connected with the early history of the Paris Observatory.

An often-quoted paragraph in Flamsteed's warrant as the first Astronomer Royal of Great Britain, charges him with definite duties and a definite program in the administration of the Royal Observatory, and serves Mr. Wolf as a text with whose singleness of purpose he contrasts the lack of plan that characterized the foundation of the French observatory. We read in substance rather than in exact translation, "In creating this institution Colbert sought to erect to astronomy and the other sciences, but chiefly to the glory of his king, a magnificent palace, whose splendor should be worthy of the prince who built it and in which the members of the newly created Academy, without being subject to any prescribed duties, should by their labors vie with each other for the royal approbation, each following his own preferences according to the inspiration of the moment. Within it laboratories were provided for the chemists and physicists, a museum of anatomy for the naturalists, etc., but the observatory was too far from the center of Parisian life, and chemists, physicists and physicians alike soon forgot the way thither, if indeed they ever learned it. For a time the astronomers responded to the munificence with which the king and his minister had provided instruments of observation for their use, but, alas, the instruments belonged to the Academy and no one in particular had charge over or responsibility for them, and like their fellow academicians of a different cloth, the astronomers in time learned that the road to the observatory was long and that their convenience was best served by deporting the instruments and doing their work at home. After a few years there were left to the observatory only the four or five *savants* who lodged within its walls, and these worked independently of each other without supervision or direction. While Paris in the sixteenth and seventeenth centuries had no lack of brilliant astronomers, down to the concluding years of the eighteenth century there was in truth no Paris Observatory in the sense that we now attach to this word, and that in England has been attached to it from the beginning, viz., a body of observers working under a common direction for a well-defined purpose. They ignore these conditions of the observatory who reproach its astronomers for not having produced and published those well-planned and long-continued labors that constitute the foundations of astronomy, but which are possible only in an observatory properly organized." The American astronomer is perforce reminded by these lines of analogies with another scientific institution much nearer home.

In the early years of the observatory the chief authority exercised within it seems to have been vested in the concierge, whose office was one of considerable dignity and eagerly sought by members of the Academy. The first real director was not appointed until 1771, when the third Cassini (de Thury) came into office. Serving through the dark days of the Revolution, he protested manfully against out-

rage and indignity, but was helpless to prevent the ransacking and plunder of the observatory by armed miscreants, and his downfall, directly due to political conditions and attended by the insults and petty persecutions of his former subordinates, marks the close of the present volume, although Mr. Wolf's significant paragraph, 'He retired to his estate at Thury, where we shall encounter him in the sequel of this history,' suggests a volume still to follow.

Scattered throughout the present work are to be found interesting glimpses of scientific life and work in bygone generations: *e. g.*, the first Cassini seeking to introduce into France, from his native Italy, the arts of glass making and telescope building as prerequisites to the growth of astronomy; and a casual account of the very long telescopes then in vogue, with a welcome explanation of the manner in which observations were conducted with an objective and ocular placed a hundred, or more, feet apart with no intervening tube. Turning to matters of a more personal character, we catch glimpses of Academicians quarreling over rights of domicile in chambers hung with tapestry but devoid of beds and tables. With more of mirth than surprise do we find one of the Cassinis protesting in vain, that the observatory windows should be glazed before he is required to store within it unwelcome instruments thrust upon him by administrative decree; and with very different emotions we read the pathetic account of Picard, close to the discovery of the aberration of light a century before Bradley's time, but dying just before completion of the instruments that had been ordered expressly for investigation of the suspicious phenomena.

In mechanical execution the volume worthily maintains the traditions of the house of Gauthier-Villars, but its usefulness is impaired by lack of an index.

GEORGE C. COMSTOCK.

MADISON, WIS.

The Grasses of Iowa. By L. H. PAMMEL, Ph.D., J. B. WEEMS, Ph.D., of Iowa State College of Agriculture and the Mechanic Arts, and F. LAMSON-SCRIBNER, Agrostologist, U. S. Department of Agriculture, Des Moines, Iowa. F. R. Conway, State Printer, 1901. Bulletin No. I, of the Iowa Geological Survey. Pp. 525; with 11 plates and 514 engravings.

This is a great credit to the author and to the State Geologist who had the good sense to secure its preparation. The work treats of anatomy of the grasses, the roots, stems, leaves, flowers, grain, hybrids; purity and vitality of grass seed, cereals, fungus diseases of grasses, bacterial diseases, pastures and meadows of Iowa, weeds of meadows and pastures, chemistry of foods and feeding, lawns and lawn making in Iowa. The plates and figures are excellent and the whole work seems to be up-to-date, excepting some of the names of plants. Nearly all of the grasses of the state are illustrated, some legumes and weeds.

The authors must have devoted much time in making investigations, reading the best modern works on the subjects treated, including reports of scientific societies, bulletins of the U. S. Department of Agriculture, and of the numerous State Experiment Stations. There are many instances given showing that numerous wild grasses are superior for cultivation to those introduced from Europe. The following are the most important grasses for the State of Iowa: *Poa pratensis, Phleum pratense, Bromus inermis, B. breviaristatus, Dactylis glomerata, Agropyron spicatum, Andropogon provincialis, A. nutans, Agrostis alba, Calamagrostis Canadensis, Panicum virgatum.* For general cultivation *Poa pratensis, Phleum pratense,* and *Bromus inermis* are the most valuable; for shaded ground *Dactylis glomerata* and *Agrostis alba;* for low grounds *Agrostis alba, Poa serotina, P. pratensis, Calamagrostis Canadensis;* for dry hills *Bouteloua oligostachya, B. racemosa;* for alluvial bottoms *Andropogon provincialis,* and *Spartina cynosuroides;* for the loess of western Iowa *Agropyron spicatum, Andropogon scoparius.*

Large numbers of chemical analyses were made in grasses in their natural condition and when free from water, indicating the per cent. of fat, protein, albuminoids, crude fiber, ash and nitrogen-free extract.

The index is unusually complete, which greatly aids the use of the volume.

The work contains but little that will interest the farmer, nor can it be expected that any person could prepare such a work, on account of the necessary technicalities of the subject, but it is just the thing to fall into the hands of the botanist, the professor of agriculture and students pursuing an agricultural course.

W. J. BEAL.

AGRICULTURAL COLLEGE, MICH.

Elementary Course of Practical Zoology. By the late T. JEFFREY PARKER and W. N. PARKER. London, Macmillan & Co. 1900. Pp. 608; 156 illustrations.

Although this book was published abroad about eighteen months ago, it is practically recent in this country, having been introduced by the New York publishers during the present academic year. It is not yet widely known and has not received from American teachers and students of zoology the attention which it deserves.

Almost twenty-five years ago Huxley wrote in the preface to his now classical 'The Crayfish as an Introduction to the Study of Zoology' these words: 'I have desired to show how the careful study of one of the commonest and most insignificant of animals leads us, step by step, from everyday knowledge to the widest generalizations and the most difficult problems of zoology; and, indeed, of biological science in general.' Every zoologist knows how well Huxley succeeded in introducing the readers of 'The Crayfish' to the great principles and methods of the science. Unfortunately, the work was better adapted for reading than for the modern laboratory method of teaching, and hence this masterpiece among introductory books on zoology has become a reference work. But its central idea has made a deep impression on the teaching of zoology, and it is therefore with pleasure that we welcome a book in which the pupils of the master of zoological teaching have given his suggestion a new and more complete development in adaptation to the laboratory method. In the 'Practical Zoology' by the Parker brothers we now have in the form of a handbook for students an introduction to zoology based upon Huxley's idea of a careful study of a common animal considered from the standpoint of the several phases of zoology. But the frog and not the crayfish is the chosen type.

One might infer from the title that the book is exclusively a laboratory manual; but, on the contrary, there are extensive descriptions of the types to be studied in the laboratory and good presentation of zoological principles, so that the book is really a text-book and laboratory manual combined.

In Part I., consisting of 228 pages, the frog is thoroughly treated with regard to anatomy, histology, physiology, embryology, classification and ecology—the whole forming a splendid introduction to fundamental zoological principles and methods of study.

Following the study of the frog as an introduction to the study of zoology, Part II. deals with *Amœba, Hæmatococcus, Euglena, Paramœcium* and its allies, *Hydra* and hydroids earthworm, crayfish, mussel, *Amphioxus,* dogfish and rabbit. The book closes with some general points in cytology and embryology which have been incidentally referred to in earlier parts of the work.

Most of the descriptive chapters in Part II. are essentially reprints from T. J. Parker's well-known 'Elementary Biology,' even the illustrations of the book being reproduced with additional ones from Parker and Haswell's 'Zoology.' But, although the material is familiar, the setting is decidedly new; and these latter chapters supplement the introductory study of the frog so as to form a well-rounded course in general zoology.

Excellent practical directions for obtaining, preparing and studying zoological materials form appendices to all the chapters, and these are so arranged that the laboratory study proceeds hand in hand with the reading of the descriptions. Those teachers of the American school who have been influenced by the laboratory methods of both Agassiz and Huxley will criticise these directions for practical study, in that the work of the student is practically limited to mere verification. However, the laboratory teacher who wishes to stimulate the spirit of investigation will find no difficulty in

suggesting modifications and substitutions which will give the students some work for investigation in place of continuous verification.

The greater part of the descriptive sections of the 'Practical Zoology' is from the pen of the late T. Jeffrey Parker, and we note all the characteristics which made his 'Elementary Biology' so popular. It is an interesting and excellent book; and, in the reviewer's opinion, a better single volume offering a year's course in general zoology has not yet appeared.

M. A. BIGELOW.

TEACHERS COLLEGE,
COLUMBIA UNIVERSITY.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

AT the May meeting of the Section, Professor R. W. Wood, of the Johns Hopkins University, read a very interesting paper on 'Anomalous Dispersion and its Bearing on Astrophysical Problems,' making special reference to the explanation of the flash spectrum in this way.

Dr. William S. Day, Columbia University, read a paper on 'An Experiment Relating to the Application of Lagrange's Equations of Motion to Electric Currents.'

The experiment described was analogous to one mentioned by Maxwell in his 'Treatise on Electricity and Magnetism,' Section 574, Volume II. Maxwell's experiment was made for the purpose of discovering whether or not in the expression for the kinetic energy of an electric current there was a term depending on the product of the current and the velocity of the conductor. In a single linear circuit having only one degree of mechanical freedom, the expression for the kinetic energy of the system in the most general case would be of the form

$$T=\tfrac{1}{2}I\dot{x}^2+K\dot{x}\dot{y}+\tfrac{1}{2}L\dot{y}^2$$

in which $\dot{x}$ is the velocity of the mechanical coordinate, $\dot{y}$ is the current, I is a quantity of the nature of mass, L is the self-induction of the circuit, and K is the coefficient of the term consisting of products. Just what mechanical coordinate is to be represented by x is partly a matter of choice. Maxwell chose one whose velocity means a motion of the wire in the direction of its length. There is one other coordinate which seems to be geometrically possible, although it is not one that is naturally suggested by the most satisfactory hypotheses now in vogue as to the nature of an electric current. This other coordinate is one such that its velocity means a rotation of the wire carrying the current around its axis of figure. If x has this meaning, then if the coefficient K is not zero, Lagrange's equations of motion show that if a current is suddenly started or stopped in a wire there would be an impulsive torque acting on the wire. The experiment was performed to look for such an effect if it existed. A straight piece of aluminium wire 30 cm. long and 0.25 cm. in diameter was suspended by a quartz fiber in such a way that it was free to rotate, and by means of mercury cups a current could be passed through it at pleasure. No effect of the kind considered was detected. If the value of K expressed in C.G.S. electromagnetic units, and referred to a centimeter length of the wire, had been as great as 0.00002, it could have been detected.

S. A. MITCHELL.

SCIENTIFIC JOURNALS AND ARTICLES.

THE May number (Vol. VIII., No. 8) of the *Bulletin of the American Mathematical Society* contains the following articles: 'The March Meeting of the Chicago Section,' by T. F. Holgate; 'Concerning Angles and the Angular Determination of Planes in 4-Space,' by C. J. Keyser; 'Note on the Sufficient Conditions for an Analytic Function,' by D. R. Curtiss; review of Scheffers's 'Theory of Surfaces,' by J. M. Page; review of 'Recent Books on Mechanics,' by E. B. Wilson; 'The Galois Theory in Burnside and Panton's Theory of Equations,' by B. S. Easton; 'Shorter Notices'; 'Notes'; 'New Publications.' The June number (Vol. VIII., No. 9) contains: 'The April Meeting of the American Mathematical Society,' by F. N. Cole; 'The Infinitesimal Generators of Parameter Groups,' by T. J. I'a. Bromwich; 'On the Parabolas (or Paraboloids) through the Points Common to two Conics (or Quadrics),' by T. J. I'a. Bromwich; 'A Second Definition of a Group,' by E. V. Hun-

tington; 'Determination of All the Groups of Order p^m, p being any Prime, which Contains the Abelian Group of Order p^{m-1} and of Type (1, 1, 1, . . .),' by G. A. Miller; 'A Class of Simply Transitive Linear Groups,' by L. E. Dickson; 'Errors in Legendre's Tables of Linear Divisors,' by D. N. Lehmer; review of 'Recent Books on Mechanics,' by E. B. Wilson; review of Kiepert's 'Calculus,' by E. W. Davis; 'Correction'; 'Notes'; 'New Publications.'

DISCUSSION AND CORRESPONDENCE.

FORCE AND ENERGY.

To the Editor of Science: In my address, published in your number for July 4, I have used the word 'force' without saying as clearly as I should have done that it is used in the sense of energy, as that term is now applied in physics. It seemed to me that to a general audience force would be more significant. As Helmholz wrote of the Erhaltung der Kraft, perhaps an outsider may be pardoned for using 'force' with the above defined meaning.

Charles S. Minot.

Boston, July 5, 1902.

ETHER WAVES FROM EXPLOSIONS.

About a year ago the writer began a systematic attempt to examine into the effect of explosions upon the ether. A few prior experiments had yielded results explainable on the assumption that such action existed. The investigation was suggested by Young's observation upon a solar outburst as given in his work on the sun.* The Greenwich magnetic curves which Young gives for the dates August 3 and 5, 1872, are so persuasive in their character that an attempt was made to reproduce these results by a terrestrial explosion. It was also thought that the motion of rifle bullets might yield some recognizable result.

It seems probable that, in order to produce a magnetic disturbance, recognizable by a needle, the explosion should be as large and violent as possible. With the coherer as a receiver, it would seem that sharpness of the explosion and atomic periodicity might be more directly involved.

* 'The Sun,' 1881, pp. 156–159.

The work has been attended with great difficulty. The buildings and grounds of Washington University, where the work has been attempted, are in the heart of the city of St. Louis, and street cars are almost continually passing. Only between two and three o'clock in the morning was it found possible to obtain brief intervals fairly free from great disturbance. Even then the needle was continually in motion. The explosions at such an hour were necessarily limited in violence by the possibilities of damage to property, and have been doubtless an outrage upon people who wished to sleep.

So far the results have been inconclusive. Deflections have been obtained, but they have not been reducible to any system which could be rationally explained. It was apparent that the sound wave and the shock have been involved. This work will be carried on in the open country, where larger explosions can be made at a distance from the receiving apparatus. In the meantime it is most interesting to know that the volcanic explosion on the island of Martinique has apparently produced the results which we had been seeking.

Francis E. Nipher.

ECOLOGY.

To the Editor of Science: Doubtless your readers are heartily tired of the discussion upon the word ecology, and I shall not attempt to reply to Mr. Bather's letter in your issue of June 20, farther than to state that his explanation does not appear to me to improve his case materially beyond providing an ample cloud to cover a graceful retreat.

But aside from the main points at issue, I agree with Mr. Bather that the use of the word ecology in such an expression as 'the ecology of a glacial lake' is somewhat unfortunate. Every botanist interested in such studies knows that this phrase is simply a convenient abbreviaton for 'the ecological relations [or features, etc.] of the vegetation of a glacial lake,' and, when used in a botanical publication, it produces no misunderstanding. Nevertheless, as the present discussion has shown, it may mislead others, and therefore botanists could better use the word in such a way as to make

clear to all the real nature of the subject under consideration.

W. F. GANONG.

THE EUROPEAN POND-SNAIL.

TO THE EDITOR OF SCIENCE: It may prove of interest to some of your readers, interested in geographical distribution and its problems, to learn that there is a well established colony of the European pond-snail *Limnœa auricularia* Linnæus in Flatbush (Brooklyn). So far as I am informed this is the only occurrence in America of the well-known 'wide-mouthed mud shell' as it is called in England. The colony is well established, a number of individuals having been collected that were over an inch in length and correspondingly broad. They feed on pond-lily leaves, destroying the epidermis on the under side almost completely. They were no doubt introduced through accident on water plants, since the pond contains several well-known European hydrophytes. Inasmuch as the visits of water birds to this pond may lead to the young shells being carried away to stock other ponds, the occurrence of this species should be recorded.

B. ELLSWORTH CALL.

BROOKLYN, June 28, 1902.

TEXT-BOOKS.

THE evolution of educational methods in this country is interestingly set forth by President Harper in 'The Trend of University and College Education in the United States' (*North American Review,* April, 1902) and the university of the future is portrayed as centering about the library. Professor Harper names two centers for the university —the library and the laboratory; but for present purposes the laboratory may be regarded as the workshop in which are tested the 'receipts' of the text-books, so that the laboratory may in a broad sense be taken as an annex to the library.

In a university library to-day the books are so numerous as to require special training or assistance to find and use their information to best advantage. Books of course are written from many standpoints and for many purposes, from scholastic erudition to the mere passing of an idle hour, and wide is the range between the needs of the specialist and those of 'that delightfully vague person, the intelligent reader,' as Mr. Haddon puts it in his introduction to 'The Study of Man.'

As text-books have been the outgrowth of the needs of schools and colleges they reflect in extent and method the needs and limitations set by the requirements of each case. And since these requirements differed widely in different institutions, the number of text-books in each subject is large and their treatment varied.

The chief peculiarity of a text-book is brought about by the fact that it has been prepared for use, not in imparting knowledge, but in the training of the student mind. Its method of presentation is therefore frequently such as to require rather the maximum than the minimum of mental effort to master its contents.

The second limitation to an ordinary text-book, as felt by one who wants only to learn facts, is that set by the length of time given that study in some particular school or college or grade of schools. Hence the ground is covered sometimes quite incompletely, and quite often a limited view is presented in a way most valuable for use in mind-training, but with important topics omitted wholly rather than a less detailed but more complete outline of the subject.

A third limitation is set by the omission of much detailed 'elementary' information imperative to a full understanding of the subject, and assumed either as already known or that it will be (but too often is not) imparted by the intelligent teacher. This criticism of the teacher is fortunately becoming less pointed as the science of teaching is being learned and put into practice.

There exists however to-day a large class of would-be pupils who by force of circumstances must be self-instructed. They are mostly tied down by the necessity of earning a living for themselves and usually for others. Their minds may or may not be trained but they want to learn the known facts and their

theoretical grouping so far as is established to date, and they want this information in the most easily assimilable form. They care not a rap for the mind-training value of a text-book. For their use it is a positive detriment and hindrance. They require first a complete if only a bare outline of the subject so that they may know the extent of the ground covered to date. Secondly, they want the subject classified and carried as far in detail as may be in one volume of convenient size. Thirdly, they want full bibliographical notes and a good index so that they may know where to look for fuller details if needed for their particular purposes.

Such is the 'fact-book' needed by two large classes in the community; the business man who if 'successful' has very little time (and if unsuccessful still less), yet must keep as far as possible abreast of scientific and other progress, and, secondly, the working artisan who aims to improve his present condition by learning facts, the knowledge of which will enable him at once to command better pay through added ability to more intelligently apply the hand-skill for which his wages are paid.

A demand for this class of book is entirely aside from and in addition to the school or college text. Neither does the demand for it cast any reflection on the need and value of mind-training. Both the business man and the artisan need and would benefit by it if they could secure it. The business man to-day, more generally than ever before, has had a collegiate training, but that fact does not lessen his need of books from which to keep up to date as to facts and discoveries with the minimum of mental effort. So too the workman would benefit vastly more if he could have the mental training so that he might have 'mind-skill' to sell, but as he cannot secure the latter he has all the more need of information of the kind he can use and that presented in the simplest form.

The college of to-day makes no pretense to teach in the sense of imparting working information in any branch of study. In fact, while professing to train the mind it sometimes almost boasts that it does not furnish the detailed information needed for money winning. And widely as this fact is proclaimed, yet many, particularly poor boys, fail to appreciate existing conditions, and while their point of view may be wrong and utterly unjust to their alma mater, they sometimes, after graduation, feel that they have not received what they thought they were paying for.

A step in the evolution of education soon to be taken, if not already begun in our technical schools, will be that of presenting the known facts to the pupil with the minimum of mental effort, and then training his mind by a drill in applying the information to practical problems in the shape these are presented in commercial life. When this course shall be pursued in our colleges the graduate will have, in addition to a trained mind, a fund of information of money-value to him immediately on graduation.

An attempt to supply the existing demand for what we have called 'fact-books,' as opposed to 'text-books,' is illustrated by the series of books published by the International Correspondence School of Scranton, Pa., which, starting as a purely commercial venture, now has an enrollment of half a million scholars—mostly poor boys and working men. Its books may not be the ideal along the line suggested, neither are they as yet for sale except to their own students, but the enormous success of the school and the books which it has had prepared seem to indicate a 'want' and one attempt to meet it.

Another attempt might be considered as that made by certain publishing houses, as in Appleton's 'International Scientific Series' and Putnam's 'The Science Series'; yet valuable as are these books, they have not been prepared to meet the exact requirements to which attention has just been drawn.

J. Stanford Brown.

New York, N. Y.,
April 5, 1902.

SHORTER ARTICLES.

A NEW METEORITE FROM KANSAS.

THE Field Columbian Museum has recently received a meteorite seen to fall in Saline Township, Sheridan Co., Kansas. The chief observer of the fall was Mr. S. A. Sutton, of Hoxie, Kansas, and he was also the finder of the mass. The fall took place November 15, 1898, at about 9:30 P.M., the circumstances being thus described by Mr. Sutton: On the date mentioned he was about to retire for the night when a great light seemed to flash in his house accompanied by a rushing noise. He supposed a large lamp in an adjoining room was exploding, but on hurrying to the room saw instead a great fiery mass passing the window near him. Its path was nearly horizontal and the direction of motion northwesterly. The light given off was white and intense like that of an electric light, and a fiery trail several hundred feet long with sparks of various colors followed in its wake. The whole made a beautiful as well as awe-inspiring spectacle. The light was so intense as to illuminate the entire house and was noticed by other members of the family besides Mr. Sutton.

Whether it was noticed by others in the region has not been positively ascertained as yet, but as the territory is sparsely populated it may be that no other observer will be found.

Mr. Sutton, being a surveyor by profession, at once began to form as accurate estimates as possible of the speed, direction of motion, etc., of the mass, in order to enable him to discover where it would be likely to strike the earth. The speed he estimated at one mile per second, the angle with the horizon as 25° and that with the meridian as 20° west of north. These estimates led him to conclude that the point of fall would be about four miles from his home, but all subsequent searching in that region proved futile. At the end of nearly three years, however, he made a recalculation in which he assigned a greater speed to the meteorite than he had before done. This indicated that the point of fall might have been about eight miles away. Seeking in this locality, his efforts were rewarded in the fall of 1901 by finding the meteorite in the bank of a 'draw.' It had penetrated the soil to an underlying limestone stratum on which it lay. The thickness of soil at the time of excavation was considerable, but this might have undergone considerable change since the fall of the meteorite. Great credit is certainly due Mr. Sutton for the skill and persistence with which he followed up his observations.

The mass as received at the Museum has the form of an irregular, somewhat tabular, polyhedron bounded by eight approximately plane surfaces. Its weight is 68 pounds 10 ounces. It is covered, except where a few small fragments have been broken off, with a thick black crust contrasting in color to the dark gray hue of the interior. The crust is stippled with protruding metallic grains, for the most part coated with a black oxide of iron, but occasionally showing bright, and nickel-white in color. One of these protruding grains reaches a diameter of 5 mm.; the others are smaller. Cracks through the crust give the meteorite a 'baked' appearance. There are numerous characteristic pittings, for the most part oval in shape and having a length of about 2 cm. A slight coating of carbonate of lime occurs in places over the surface, doubtless formed upon the meteorite while it lay in the soil, but aside from this the mass has a remarkably fresh and unoxidized appearance. The texture of the stone is quite firm and compact. Even to the naked eye a chondritic structure is apparent and chondri about 2 mm. in diameter can be broken out.

A brief chemical and microscopical examination shows the chief constituent minerals to be chrysolite, bronzite and nickel-iron, a fuller account of which will be given in a future Museum publication. The specific gravity is 3.62. Having fallen in Saline Township, this will be the name used for designating the meteorite. The region in which it fell is one which has already within an area of 85 by 120 miles yielded five and possibly six distinct finds of meteorites of such character that they must be considered separate falls. Now that an observed fall has taken place in the region, it would seem that

some reason must be sought for the large number other than mere coincidence or the fact that the area is not forested. A further feature of interest in connection with the fall is the fact that it occurred at the time of the Leonid showers. Only two such instances have hitherto occurred within this period, these two being the falls of Werchne Tschirskaja and Trenzano. These are both veined spherical chondrites and the present indications are that Saline Township belongs in the same category.

OLIVER C. FARRINGTON.

NOTES ON THE LAFAYETTE AND COLUMBIA FORMATIONS AND SOME OF THEIR BOTANICAL FEATURES.

HAVING spent considerable time during the past two years in making a critical study of the flora of Georgia in all its aspects, I have been investigating, among other things, the influence of geological conditions on the present distribution of species. The most striking relations between geology and existing flora have been observed in the coastal plain, and I have restricted my explorations chiefly to that part of the state in order to study the interesting problems there presented.

The existing knowledge of the areal geology of the coastal plain is much less complete in Georgia than in the adjacent states, partly because the energies of the State Geological Survey have hitherto been necessarily devoted mostly to the investigation of mineral resources and other questions of more immediate economic importance, and partly because Georgia has for many years been singularly neglected by geologists and other scientific people. This state of affairs has been a source of considerable difficulty in the prosecution of my work, and has led me to undertake some geological investigations on my own account, most of those on which these notes are based having been made during the summer of 1901.

My geological observations have thus far been mostly confined to the Lafayette and Columbia formations, which as they cover almost the entire surface of the coastal plain are the most easily accessible, and at the same time are quite readily recognized even by an amateur like myself. My knowledge of these formations, aside from my work in the field, has been chiefly derived from Mr. W J McGee's monograph in the Twelfth Annual Report of the U. S. Geological Survey, and from consultation and correspondence with Mr. McGee himself; and it was at his suggestion that I undertook to prepare these notes for publication.

In addition to the ordinary way of studying geological formations by their exposures in natural or artificial excavations, I have employed in the case of the Lafayette and Columbia, with very satisfactory results, another method which has perhaps never before been utilized to any considerable extent. This method consists in identifying the formations by means of the plants growing upon them. Early in the course of my investigations I noticed that certain species of herbaceous plants seemed to occur only on the Columbia sands, and that it made considerable difference in the distribution of some other species, especially trees, whether the Lafayette clays were present beneath the Columbia or not. I then used these species as an index in determining the formations when the regular method could not be used for lack of suitable exposures or when traveling by rail. This method should not be depended upon altogether, but when used with due caution it is very helpful.

I will mention here some of the more conspicuous plants which have served thus to indicate the formations, and would suggest that it would be advisable for every geologist who studies the Lafayette and Columbia formations in the southeastern states to familiarize himself with as many of these plants as possible.

The best indicator of the Columbia formation which has come under my observation is *Eriogonum tomentosum,* a plant which when in flower, in late summer, grows three or four feet tall and is conspicuous and unmistakable. It ranges from South Carolina to Florida and Alabama, and is widely distributed in the coastal plain, extending up to its inner margin at altitudes of six hundred feet or more,

but perhaps not found in the immediate vicinity of the coast. It seems to be strictly confined to the Columbia sands, and is most abundant where this formation is thickest and driest. *Frœlichia Floridana,* a plant nearly as conspicuous but less abundant, seems to have a similar distribution in the coastal plain, though the same or a closely related species is found also on the plains of the Middle West.

Other species occurring in Georgia, apparently confined to the Columbia formation (with or without Lafayette beneath it), and large enough to be recognized from a moving train, are *Actinospermum angustifolium, Asclepias humistrata, Baptisia perfoliata, Chrysobalanus oblongifolius, Clinopodium coccineum, Croton argyranthemus, Dicerandra linearifolia, D. odoratissima, Kuhnistera pinnata, Nolina Georgiana, Paronychia herniarioides, Sarracenia flava,* and *Serenoa serrulata,* besides a host of smaller species. *Sarracenia flava* (the yellow pitcher-plant), like a few others, is occasionally found outside of the coastal plain, but within that region seems to be confined to the Columbia formation. It is a very conspicuous plant when growing in large colonies, and can be recognized at a considerable distance. The two *Dicerandras* (belonging to the mint family) can sometimes be recognized by their odors alone, and might therefore be useful in traveling at night. Their flowers are autumnal.

Berlandiera tomentosa, Cratægus æstivalis (the well-known 'May-haw' of Southwest Georgia), *Dichromena latifolia,* and doubtless several other species, seem to be confined to the Lafayette, with or without a thin overlying layer of Columbia, though this relation is much more difficult to determine than that between the Columbia and its vegetation, and the chances of error are consequently greater.

I do not recall at present any species which grows only on the exposed surface of the Lafayette, where the Columbia is absent, but there are probably some which are thus restricted in habitat. There are, however, quite a number of species in the coastal plain which seem to occur never where the Lafayette is present, but only on the Columbia or on outcrops of the older underlying strata. Among these are *Bumelia lanuginosa, Dichromena colorata, Erythrina herbacea, Hydrangea quercifolia, Melanthera hastata, Taxodium distichum* and *Yeatesia lætevirens,* not to mention a number of species, especially ferns, which grow usually or exclusively on limestone and could not exist on the Lafayette clay.

Lastly, *Oxypolis filiformis* and *Taxodium imbricarium* seem to indicate the simultaneous occurrence of both Lafayette and Columba.

The relations of the two *Taxodiums* (cypresses) to the geological formations are more fully discussed in a paper published in the *Bulletin of the Torrey Botanical Club* for June, 1902 (pp. 383–399). These two trees, together with the herbaceous species in the group first mentioned, are the principal plants which have been used in my investigations.

It would be impracticable to give here a detailed account of my observations on the Lafayette and Columbia formations and their distribution in Georgia, but I may do so at another time and place. I will mention, however, that I have already made notes on them in about forty of the seventy counties lying wholly or partly in the coastal plain of Georgia, and have found the above-mentioned botanical relations to hold true wherever it has been possible to verify them. The Columbia seems to vary little in composition and appearance throughout this region, though differing considerably in thickness and mode of occurrence in different parts of Georgia. The Lafayette, on the other hand, seems to vary more in appearance than in mode of occurrence. The two formations are very distinct in Georgia, however much they may appear to intergrade elsewhere. In many railroad cuts in the southeastern part of the state it is possible to locate the line of contact between them within an inch or two.

The term Columbia is of course applied here to the superficial layer of light-colored sand which covers so large a part of the pine-barren region, and differs in some respects from this formation as represented at its type-locality; this geographical variation being analogous to that exhibited by so many species of

plants and animals and often affording a basis for specific distinctions.

In the late Dr. Charles Mohr's 'Plant Life of Alabama,'* which deals more exhaustively with geological features than any state flora previously published, these superficial sands are designated as 'Ozark sands' (doubtless named for Ozark, Ala.), a term which I have not seen used elsewhere. This formation is only mentioned three or four times in the work, however; so Dr. Mohr perhaps failed to perceive its important bearing on the distribution of the flora. If the 'Ozark sands' should ever be regarded as distinct from the typical Columbia, the superficial sands of South Georgia would of course be classed with them.

On my travels during the past summer frequent use was made of Mr. McGee's map (accompanying his monograph already mentioned) of the areal distribution of the Lafayette and Columbia formations, which I found to be remarkably accurate (in Georgia, at least), considering the small scale on which it is drawn and the large amount of territory covered by its author. Most of the discrepancies between the map and the observed conditions were naturally found in those regions never explored by Mr. McGee or any other geologist.

With a good series of maps, especially topographic maps, of the southeastern coastal plain it would not be difficult to trace with considerable accuracy the areas covered by the Lafayette and Columbia formations, but no topographic maps of any considerable portion of the coastal plain of Georgia have yet been made, and the data for them are as yet very meager. It is not even possible to get level notes from all the railroads in South Georgia, and the same condition doubtless exists in the corresponding portions of the adjoining states.

Roland M. Harper.

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INSTINCT IN SONG BIRDS. METHOD OF BREEDING IN HAND-REARED ROBINS (MERULA MIGRATORIA).

On June 17, 1902, a pair of robins (*Merula migratoria*) confined in a large room with some hundred and fifty other birds, of various sorts, hatched eggs which had been laid for some twelve days. This pair of robins were birds about four years old, and were what are known as hand-reared birds. I had taken them when very young from wild parents and raised them by hand.

On examining the nest after the second day I found there was only one young bird. It appeared to be perfectly healthy and normal, and so matters went on until the fourth day. On the morning of the fourth day I found the young robin had disappeared from the nest, but the female bird was still brooding. It now occurred to me to substitute two wild young, rather older, from a nest of robins that had been hatched out of doors in the yard. I introduced these two young birds to the parent birds, with some remonstrance on their part, but within five minutes of the time when I placed them in the nest the old birds were feeding them, and were apparently as solicitous for them as if they had been their own. At the close of the day, the substitution having been accomplished early, and I having watched the birds closely, it appeared to me that only one of the two young birds was being fed, and I took the other from the nest to rear it by hand.

Both young birds are now going about, beginning to fly, learning to eat unaided, etc., I feeding one, and the male parent robin feeding the other.

The following comments suggest themselves to me:

To go back in the history of the parent birds, they were birds that were taken from a nest in May, 1898, and were naked and blind, probably not more than three days old when adopted. The usual method of procedure which I have employed in rearing wild birds by hand is to take an entire brood and nest, and keeping the young birds as undisturbed as possible, to do practically as near what the old birds do as is attainable.

It is unnecessary to suggest that the parent birds I am speaking of are healthy and vigorous, because the very fact that they have bred in captivity seems to determine this. A word seems essential to their method of nest-build-

* 'Contr. U. S. Nat. Herb.,' Vol. 6, 1901.

ing. All the robins that I have in captivity, some sixteen or seventeen in number, of which three or four pairs breed annually, are unable to build a nest-structure, though furnished with every facility, except under particular conditions which I am about to relate. They have been unable apparently to erect a nest of the conventional robin type. The trees in the room in which they are confined seem to present every kind of fork and crotch and angle of branch that robins select out of doors for nest sites. After watching these birds for two years in their efforts to build nests, when they were supplied with every material, the *mud* for the *cup* and all kinds of *grasses* and *rootlets* for the foundation and superstructure, I found that apparently they were unable to formulate a nest that would stay together. I therefore provided them with small circular baskets, which were at once taken possession of, and generally the process of nest-building was as follows: They selected various grasses and rootlets, and after much work, covering a period of some three or four days, they lined the baskets in a manner that seemed to them satisfactory, when they proceeded to lay eggs and go through the ordinary and regular processes of robins' lives during the breeding season. However, in most cases they were so much interfered with by the other birds at large in the room with them that they failed to succeed in hatching their eggs; or, if they did hatch them, the young were destroyed by other birds whenever an opportunity was given.

It is rather difficult in such a heterogeneous company to determine exactly what transpires; but this is about the case: They do not attempt to build any *cup of mud* in such a nest as I have indicated, but the particular pair of robins in question did not put a *mud floor* in the basket. I was unable to see them feed or take care of the very small young robin which I observed in their nest and which was their own progeny, during its early infancy; but when I substituted the foster-children, as I may call them, that were older than the young bird, all the operations of feeding and taking care of the young were apparent. The female bird brooded the young ones for periods of from fifteen minutes to an hour, while the male bird constantly brought her food for the young. He also *removed all excrement as it was evacuated* and carried it at least ten feet away from the nest, and generally farther. Twice I saw him eat the excrement after he had laid it on the floor. I have watched robins carefully out of doors; and so far as I am able to judge, these robins in captivity went through all of the actions and attained all the results that robins attain with broods out of doors. It is not a little singular that they neglected, or that I fancied they neglected, to take care of one of the young ones, and that their attention was entirely concentrated on a single bird. All of these actions that I have recorded must have been instincts awakened by the various stimuli which precede instinctive acts, for no education by imitating the acts of older birds was possible.

It is also interesting in this connection to record the fact that another pair of robins breeding, or attempting to breed, under similar conditions, so far as I know have failed to lay eggs, or their eggs have been stolen by other birds after they were laid. However, the female parent is incubating and is fully as '*broody*' as any hen would be under like circumstances. That is, I may go up to the nest where she sits, and it is absolutely necessary for me to take her from the nest by force if I wish to see what is beneath her. At such times she bites my finger and fights, and when removed from the nest, utters all the alarm cries and notes that a bird out of doors does when disturbed.

The special point to bear in mind in considering the foregoing records is the fact that all of the birds in question were hand-raised—birds that cannot have gained anything by experience or education from acts performed by their parents; and all of their doings that I have recorded I suggest are in the line of pure instinct.

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A NEW SHORT METHOD OF MULTIPLICATION.

THE following method of multiplication has been tested by several years' constant use and

appears to offer marked advantages over other methods where logarithms are inadequate. A vital defect in the methods commonly used lies in the fact that the result is obtained from the right; that is, the digits of lower order in the product are obtained first. The following method is free from this defect and has the further advantage that the approximation may be carried to any degree of accuracy. Those methods which require the writing of the digits of the multiplier in inverse order are objectionable in that such a process invites error. The summing of a number of partial products is not only objectionable in itself, but renders uncertain the magnitude of the error arising from the dropping of final digits. The continued attention required in obtaining a long partial product is again a fruitful source of error. It will be seen that none of these objectionable features appear in this new method.

The method is easiest explained by a few examples. Let it be required to multiply 324 by 516. The process is shown thus:

```
324
516
------
154024
 1316
------
167184
```

The work in detail, which of course is all done mentally, is as follows: Obtain the following products, and sums of products:

$3\cdot 5=15$
$3\cdot 1+2\cdot 5=13$
$3\cdot 6+2\cdot 1+4\cdot 5=40$
$2\cdot 6+4\cdot 1=16$
$4\cdot 6=24$

Set these results down in order, placing the units figures of each result one place to the right of the units figure of the preceding result. Then add. The operation might be written:

```
15
 13
  40
   16
    24
------
167184
```

but the arrangement shown above is clearly neater.

The rule is entirely similar for numbers of four or more digits. Thus the product $1543\cdot 2789$ may be exhibited as follows:

```
1543
2789
-------
2519827
178360
-------
4303427
```

or in detail:

$1\cdot 2=2$
$1\cdot 7+5\cdot 2=17$
$1\cdot 8+5\cdot 7+4\cdot 2=51$
$1\cdot 9+5\cdot 8+4\cdot 7+3\cdot 2=83$
$5\cdot 9+4\cdot 8+3\cdot 7=98$
$4\cdot 9+3\cdot 8=60$
$3\cdot 9=27$

Arrange as before and add. The product of two numbers containing five digits each is obtained as follows:

```
3.1415
2.7183
----------
6.18382515
2.3557143
----------
8.53953945
```

or in detail:

$3\cdot 2=6$
$3\cdot 7+1\cdot 2=23$
$3\cdot 1+1\cdot 7+4\cdot 2=18$
$3\cdot 8+1\cdot 1+4\cdot 7+1\cdot 2=55$
$3\cdot 3+1\cdot 8+4\cdot 1+1\cdot 7+5\cdot 2=38$
$1\cdot 3+4\cdot 8+1\cdot 1+5\cdot 7=71$
$4\cdot 3+1\cdot 8+5\cdot 1=25$
$1\cdot 3+5\cdot 8=43$
$5\cdot 3=15$

Arrange as before and add. If the result were desired to four decimals only, the work would be:

```
3.1415
2.7183
6.1838
2.3557
------
8.5395
```

It is interesting to make this last multiplication by the ordinary method and compare.

```
    3.1415
    2.7183
    ------
     94245
   251320
    31415
  219905
  62830
----------
8.53953945
```

The number of auxiliary digits is 27 in the last as against 17 in the first. We have further a tedious addition to perform. It is moreover clear that if only four decimals are sought we have written down a mass of figures in the ordinary method only to throw them away in the end.

In the preceding examples the two factors have contained each the same number of digits. If this is not the case we may imagine the vacancies filled with zeros and proceed as before. For example,

$$\begin{array}{l} 187235 \\ \quad 213 \\ 2252914 \\ 17351915 \\ \hline 39881055 \end{array}$$

The successive operations are:

$$\begin{array}{l} 1\cdot 2=2 \\ 1\cdot 1+8\cdot 2=17 \\ 1\cdot 3+8\cdot 1+7\cdot 2=25 \\ 8\cdot 3+7\cdot 1+2\cdot 2=35 \\ 7\cdot 3+2\cdot 1+3\cdot 2=29 \\ 2\cdot 3+3\cdot 1+5\cdot 2=19 \\ 3\cdot 3+5\cdot 1=14 \\ 3\cdot 5=15 \end{array}$$

If the digits are somewhat large it may happen that the product sum contains three digits. Three rows of auxiliary figures are then necessary. Thus:

$$\begin{array}{l} 396 \\ 994 \\ \hline 27 \\ 10890 \\ \;\; 14724 \\ \hline 393624 \end{array}$$

Or in detail:

$$\begin{array}{l} 3\cdot 9=27 \\ 3\cdot 9+9\cdot 9=108 \\ 3\cdot 4+9\cdot 9+6\cdot 9=147 \\ 9\cdot 4+6\cdot 9=90 \\ 6\cdot 4=24 \end{array}$$

The same rule must always be observed in arranging the product sums.

When there are two or more equal digits in the multiplier the ordinary method would seem to be preferable, since the corresponding partial products are equal. This advantage is more than balanced in the new method by the resulting simplification in the product sums. Thus in the last example the operations may be written,

$$\begin{array}{r} 3\cdot 9=27 \\ (3+9)9=108 \\ 3\cdot 4+(9+6)9=147 \\ (6+4)9=90 \\ 6\cdot 4=24 \end{array}$$

It is seen that the simplification occurs not only when there happens to be a pair of equal digits in the multiplier, but also when there is a pair in the multiplicand or even when one is in the multiplier and one in the multiplicand. A little practice enables one to catch sight of these pairs and the labor is materially decreased in this way. This feature makes the method particularly advantageous in squaring a number. Thus:

$$\begin{array}{l} 3.1415 \\ 3.1415 \\ \hline 9.6141810 \\ \;.25484125 \\ \hline 9.86902225 \end{array}$$

The operations are,

$$\begin{array}{r} 3\cdot 3=9 \\ (3+3)\cdot 1=6 \\ (3+3)4+1\cdot 1=25 \\ \text{etc.} \end{array}$$

A formal proof of the above method is hardly necessary. The method itself was discovered by inspecting the coefficients in the product of two polynomials,

$$\begin{array}{l} a_1x^2+a_2x+a_3 \\ b_1x^2+b_2x+b_3 \end{array}$$

The product is

$$a_1b_1x^4+(a_1b_2+a_2b_1)x^3 + (a_1b_3+a_2b_2+a_3b_1)x^2 + (a_2b_3+a_3b_2)x+a_3b_3$$

Since we may write any number as 375 in the form

$$3\cdot 10^2+7\cdot 10+5$$

the reason for the method is obvious.

It is not difficult also to work out a similar short method of division which seems to possess advantages over the ordinary method.

The method of multiplication described above is to be carefully distinguished from the familiar 'cross-multiplication' (*multiplicato*

per crocetta).* That method, which is of unknown antiquity, is open to two very grave objections. The first is that the result is obtained from the right. The second is that the attention must be continued from the first to last. As a consequence of this last objection no one but a very clever computer can use the method with any success.†

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* Cantor, 'Geschichte der mathematik,' Band 2, p. 286. Also 'Das Rechnen in 16. Jahrhundert,' von P. Treutlein, *Zeitschrift für Math. und Physik*, Suppl. zu XXII., 1877, p. 49.

† Since writing the above my attention has been called by Professor D. E. Smith to a method described by El-Hassâr about the 12th century, which has some points in common with mine. For an account of his work see an article by Suter, 'Das Rechenbuch des Abû Zakarîjâ El-Hassâr' in *Bibliotheca Mathematica*, II_3 p. 16 (1901). El-Hassâr obtains his product from the left, but adds each cross product as he obtains it, thus making the work complicated and confusing.

CURRENT NOTES ON METEOROLOGY.

ECLIPSE METEOROLOGY.

THAT interesting subdivision of meteorology which is concerned with the meteorological phenomena of solar eclipses is developing rapidly. Professor F. H. Bigelow, of the Weather Bureau, devotes the whole of 'Bulletin,' a quarto of 106 pages, to 'Eclipse Meteorology and Allied Problems.' In this memoir he gives the results of a critical study of the direct meteorological phenomena of the solar eclipse of May 28, 1900, as well as a discussion of certain relations between solar and terrestrial meteorology in connection with the magnetic and electric fields in the atmospheres of sun and earth. Professor Bigelow has devoted himself very largely for several years past to this latter subject, and his work along these lines has already become well known to those who have a special interest in them. Professor Bigelow has persistently maintained that investigation of solar magnetic and allied problems is an essential to the further advance of scientific meteorology, and he has labored steadily and enthusiastically towards the solution of some of these complex problems.

The portion of the 'Bulletin' which is more immediately related to the purpose of these Notes concerns the meteorological work done by the eclipse expedition to Newberry, S. C.; the special meteorological observations at sixty-two Weather Bureau stations, and a considerable number of voluntary special observations. On the basis of these data Professor Bigelow has made studies of the variations in pressure, temperature, vapor tension and wind caused by the passage of the shadow; of the shadow band phenomena, which appear to be due to meteorological conditions exclusively; and has also computed the number of calories of heat per kilogram absorbed at the earth's surface by the shadow. As to the variations in pressure, it appears that the *mean* curve, based on pressure readings made at a number of stations, is so smooth that it cannot be positively asserted that the eclipse caused a rise shortly before totality, or a drop later. The temperature curves show clearly defined variations, the greatest lowering of the temperature being about 3.5° in the total shadow. The vapor pressure curves are very irregular, but the means show that there was a decrease of vapor tension of about 0.01 inch at the time of the maximum cooling of the air. There was a decrease in the wind velocity of about one mile per hour caused by the eclipse shadow, but Professor Bigelow's results as to wind direction seem to him to indicate 'that there was no definite change in the azimuth which could be attributed to the eclipse.' The facts seem to Professor Bigelow to 'exclude the possibility that any sort of a true cyclonic circulation was generated by the action of the cooling effect of the moon's shadow on the atmosphere.' In this, Professor Bigelow is not in agreement with Mr. H. H. Clayton's results (*Annals Harv. Coll. Obsy.*, XLIII., Part I., 1901, 1–33. See also SCIENCE, April 12, 1901, 589–591; May 10, 1901, 747–750), to a discussion of which some attention is given. Professor Bigelow

computes that the number of calories absorbed increased to 4.40 at 15 minutes after totality, and then decreased to zero at about 93 minutes after the totality. From 15 minutes after totality to 45 minutes after totality there was very little change. A study of the shadow bands leads to the conclusion 'that the shadows were crescent shaped, and had a flickering motion as if struggling through two or more conflicting movements in the atmosphere itself.' This, as above stated, makes it appear to Professor Bigelow that the phenomenon is due exclusively to meteorological conditions.

RAINFALL VARIATIONS.

A VALUABLE study of the variations of rainfall during long periods of time has recently been made by Hann ('Die Schwankungen der Niederschlagsmessungen in grösseren Zeiträumen,' *Sitzungsber. Wien. Akad.*, CXI., IIa, 1902). The data used as the basis of the discussion are the monthly and yearly mean rainfalls for Padua (from 1725 to 1900); Klagenfurt (from 1813 to 1900) and Milan (from 1764 to 1900). For the past hundred years (1801–1900) the annual extremes expressed in percentages of the general mean are as follows:

	Padua.	Klagenfurt.	Milan.
Driest year,	58	42	62
Wettest year,	152	151	152

Classifying the wet and dry years during the last century according to their percentage departures from the general mean, the following table is obtained:

Character.	Very Dry.	Dry.	About normal.
Per cent.,	51–70	71–90	91–110
Number,	8	26	37

Character.	Wet.	Very Wet.	Extraordinarily Wet
Per cent.,	111–130	131–150	over 150
Number,	22	6	1

It is seen that the dry years number 34 per cent. and the wet years 29 per cent. The rainfall of the wet years, however, departs to a greater extent from the mean annual value than does that of the dry years. When the mean epochs of these dry and wet periods are determined, it appears that they show a 35-year periodicity, the maxima and the minima coming in the following years:

Wet,	1738	1773	1808	1843	1878	(1913)
Dry,	1753	1788	1823	1859	1893	(1928)

This period accords with the 35-year climatic period of Brückner.

NOTES.

ACCORDING to recent information received from Mr. Maxwell Hall, who has long been well known for his work in connection with the meteorology of Jamaica, it appears that the work of collecting the statistics of rainfall, etc., has been transferred to the Island Chemist's office, and that Mr. Hall has been relieved of his duties by the Governor's order.

A FULL account of the new meteorological observatory at Aix-la-Chapelle, and of its equipment and formal opening, is given in Vol. VI. of the *Deutsches Meteorologisches Jahrbuch* for 1900 (Aachen). The same volume also contains the fifth instalment of an article on the climate of Aix-la-Chapelle, and a paper (illustrated) on two halos observed during 1900.

IN the April number of *Climate and Crops: California Section,* Professor A. G. McAdie points out that Sir Francis Drake was quite accurate in his description of the climate near San Francisco, where he anchored in June and July, 1579, as cold and foggy. Professor McAdie also criticizes the erroneous statement embodied in the article on Drake in the 'Dictionary of National Biography,' to the effect that "to speak of the climate near San Francisco or anywhere else on that coast in July in these (*i. e.*, Drake's) terms is not exaggeration, but a positive and evidently willful falsehood (Greenhow: 'History of Oregon and California')." Tables are given to show the prevalence of fog in the locality in question.

R. DEC. WARD.

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*MEMORIAL OF HALLER.**

TRÉS HONORÉ COLLÈGUE:

Dans la séance du 17 septembre 1901, le Congrès de physiologie réuni à Turin a

* Letter addressed to Professor H. P. Bowditch, of the International Committee of the Congress of Physiology.

décidé, sur la proposition de M. le Professeur Kronecker, l'organisation d'une souscription destinée à faire l'acquisition, à Berne, de la maison autrefois occupée par Albert de Haller. D'après le projet exposé au Congrès on tâcherait de réunir dans cette maison les souvenirs de Haller, les collections de ses ouvrages, ses manuscrits, bref, tout ce qui peut donner aux visiteurs l'idée de la prodigieuse activité dont Haller n'a cessé de faire preuve jusqu'au moment de sa mort.

D'autre part, la ville de Berne se prépare à fêter, le 8 octobre 1908, le deux-centième anniversaire de la naissance d'Albert de Haller. Il importe donc de se préoccuper dès maintenant de l'organisation de la souscription internationale.

On sait l'extraordinaire mérite du grand physiologiste bernois; son génie fut universel et son travail immense; nous devons honorer en lui à la fois le savant, le littérateur et l'homme d'Etat.

Albert de Haller a fondé a Berne un institut d'anatomie où il enseigna gratuitement; c'est lui qui composa la première Flore helvétique; il fut médecin la l'hôspital de Berne, conservateur de la collection des médailles, bibliothécaire; membre du Comité d'hygiène de la ville, il indiqua les premières règles d'hygiène sociale, préconisa les inoculations, l'isolement des personnes atteintes de maladies infectieuses, etc.

Haller a laissé près de deux cents ouvrages en allemand, en latin et en français.

A l'âge de vingt-huit ans, il fut appelé à occuper à Göttingen les chaires d'anatomie, de botanique et de chirurgie. C'est dans cette ville qu'il fonda la célèbre Société royale des sciences, dont il fut le premier Président; il y institua an jardin botanique, un amphithéâtre d'anatomie, et il y poursuivit ses études de physiologie.

On ne saurait mieux caractériser l'influence exercée par Haller sur le développement de la méthode expérimentale, qu'en rappelant qu'il avait coutume de faire choisir, par les plus capables de ses étudiants, un sujet dans l'anatomie ou dans la physiologie et de les aider de ses conseils à condition qu'ils en poursuivissent l'étude pendant deux hivers dans son Institut. Et lui-même appréciait la valeur que de telles recherches devaient avoir en disant: 'Nicht unbedeutend ist das Licht gewesen dass sich aus diesem Institute über die Physiologie ergossen hat.' Pareille déclaration est trop modeste, car on peut affirmer avec vérité que la physiologie expérimentale, telle que nous la comprenons encore aujourd'hui a été réellement fondée par Haller. N'est-ce pas lui qui en écrivit le Code dans son ouvrage on huit volumes intitulé: 'Elementa Physiologiae corporis humani' (1757–1766)?

Tous les pays d'Europe se disputèrent l'honneur de posséder Haller et d'encourager son enseignement: l'Angleterre, le Hanovre, le Prusse et la Hollande lui firent presque simultanément les propositions les plus brillantes; ses relations s'étendaient d'ailleurs à tout le monde savant: à Leyde, il avait reçu les leçons de Boerhaave et d'Albinus; il avait achevé ses études à Londres et à Paris, et la correspondance de Haller, conservée à la bibliothèque de Berne, ne comprend pas moins de treize mille lettres émanant de mille deux cents correspondants appartenant aux pays les plus divers. Haller présente cet exemple unique dans l'histoire de la science internationale que, pour l'attacher au sol de sa patrie, il fallut que de Gouvernement de Berne rendit un décret qui le mettait en réquisition perpétuelle pour le service de la République.

L'Institut de France voulut compter Haller parmi ses huit membres étrangers et l'Académie de Saint-Pétersbourg lui décerna le même honneur en l'accentuant encore, car elle réserva l'élection de Haller pour la célébration solennelle de son jubilé et la fit coïncéder avec l'élection de Frédéric le Grand. L'Académie des sciences de Berlin, la Société royale de Londres et un grand nombre de sociétés savantes appartenant à tous les pays de civilisation ont élu Haller au nombre de leurs membres.

L'idée d'honorer d'une manière durable et exceptionnelle la mémoire du grand physiologiste de Berne devait trouver un accueil favorable auprès des membres de notre Congrès; le moment paraît venu de donner suite aux résolutions prises; *en tardant plus long-*

temps, on s'exposerait à voir la maison de Haller sacrifiée pour faire place à d'autres édifices; or, nous voudrions que cette maison fût respectée et qu'elle restât, à perpétuité, ouverte à tous les hommes de science.

Pour donner à la souscription le caractère d'universalité auquel elle nous paraît avoir droit, il est désirable que le montant des contributions individuelles ne dépasse pas la valeur de *l'unité monétaire* le (shilling, le mark, la couronne, le franc, etc.). Les noms des souscripteurs seront recueillis sur des listes séparées, de modèle uniforme, qui seront réunies à Berne et déposées dans la maison de Haller en témoignage de la reconnaissance et de l'admiration de toutes les nations du monde.

On s'efforcera d'obtenir soit de la Confédération helvétique, soit de l'Etat de Berne, la mise à sa disposition de la maison de Haller; si, comme on paraît en droit de l'espérer, cette concession était obtenue à titre gracieux, ou encore si les circonstances rendaient impossible l'acquisition de l'immeuble, le montant de la souscription serait joint aux fonds déjà recueillis par le Comité de Berne pour l'érection d'un monument érigé à la mémoire de Haller devant le nouveau palais de l'Université.

Nous osons espérer, trés honoré Collègue, que vous voudrez bien contribuer à assurer le succès de la souscription dont le Congrès de Turin a approuvé le principe.

Si vous désirez un certain nombre d'exemplaires de cette circulaire ou d'autres listes de souscription, vous voudrez bien les réclamer auprès de M. Burkhart-Gruner, trésorier du Comité de Berne (Marktgasse, 44, à Berne).

C'est à lui également que vous voudrez bien adresser le montant des souscriptions recueillies.

Veuillez agréer l'assurance de notre considération la plus distinguée.

MICHAËL FOSTER,
Président d'honneur du Congrès international de physiologie.

PAUL HEGER,
Président du VI Congrès.

Subscriptions from America may be sent to Dr. W. T. Porter, Harvard Medical School, Boston, and their receipt will be acknowledged in SCIENCE. The limitation of the subscriptions to the 'monetary unit' of the country would allow Americans to indulge in the extravagance of a dollar contribution, but twenty-five cents would be the equivalent of the foreign unit. This limitation ought to make the subscription a very popular one.—ED.

SCIENTIFIC NOTES AND NEWS.

DR. WILLIAM OSLER, professor of medicine at the Johns Hopkins University, has been given the degree of D.C.L. by Trinity College, Toronto. Dr. Osler was formerly a student at this institution.

MAJOR WALTER REED, U. S. A., has received the degree of LL.D. from the University of Michigan, as well as from Harvard University, as a recognition of his work relating to the prevention of yellow fever.

PROFESSOR EDWARD W. MORLEY delivered the address at the annual public meeting of the Ohio State University Chapter of the Society of the Sigma Xi, his subject being 'Advances in Precise Metrology.'

DR. A. N. RICHARDS, assistant in the department of physiological chemistry at the College of Physicians and Surgeons, Columbia University, has been appointed to a research fellowship in the Rockefeller Institute.

DR. P. G. WOODLEY, fellow in pathology at McGill University, has been appointed bacteriologist in the United States bacteriological laboratories at Manila.

THE University of Pennsylvania has conferred the degree of Doctor of Science on Dr. Willoughby Dayton Miller, professor of dentistry in the University of Berlin.

DR. SAMUEL SHELDON has been elected president of the New York Electrical Society.

AMONG American men of science who have sailed or who are about to sail for Europe are Professor C. S. Minot, of the Harvard Medical School, retiring president of the American Association; Dr. L. O. Howard, of the Department of Agriculture, permanent secretary of the American Association; Dr. Henry M. Howe, professor of metallurgy at Columbia University, and Professor W. A. Noyes, pro-

fessor of chemistry at the Rose Polytechnic Institute.

We regret to record the deaths of Dr. Ferdinand Sommer, formerly professor of anatomy and director of the Anatomical Institute at Greifswald, at the age of seventy-four years; and of Dr. Schröder, professor of mathematics in the Technical Institute at Karlsruhe.

We announced recently a civil service examination for piece work computers in the U. S. Naval Observatory and the Nautical Almanac Office. The position in the Nautical Almanac Office will be filled by an examination on July 15 and 16, but we are now informed that the examination for the position in the Naval Observatory will be for a miscellaneous computer at a salary of about $900 a year, and that the examination will be held on August 12 and 13. Appointments to the $1,200 grade of computer at the Naval Observatory are made by promotion from the grade of miscellaneous computer.

There will also be a civil service examination on August 12 and 13 from which it is expected that certification will be made to the position of hydrographic surveyor U. S. S. *Ranger,* at a salary of $1,600 per annum, and to other similar vacancies as they may occur.

The Council of the Horticultural Society of New York announces that it has completed arrangements for the holding of an International Conference on Plant Breeding and Hybridization on September 30 and October 1 and 2 of the present year. Acting under the instruction of the society at its annual meeting in May, 1901, the chairman of the council addressed letters of inquiry to prominent scientific societies and individuals interested in progressive horticulture, both at home and abroad, to all the Agricultural Experiment Stations in America, the United States Department of Agriculture and the Minister of Agriculture for the Dominion of Canada, in order to enlist a widespread support and to ascertain views as to the most convenient date for the attendance of the majority of those interested. The responses were unanimously in favor of holding such a conference and the dates announced were finally selected by the conference committee, consisting of Dr. N. L. Britton, chairman, Dr. F. M. Hexamer, J. de Wolf, H. A. Siebrecht and Leonard Barron, secretary. By the cooperation of the American Institute of the City of New York, it is arranged to hold the sessions of the conference in the Lecture Hall of the Berkeley Lyceum Building, 19–21 West 44th street, New York City. Arrangements are being made for the publication of a complete report of the papers and discussions in book form under the auspices of the Society. In connection with the Conference there will be an exhibition of hybrid plants and their products, and of the related literature, to which everyone is invited to contribute. Awards of the society in the form of medals, diplomas and certificates may be made to exhibits of plants and plant products of hybrid origin illustrating some particular plant or plant industry.

Dr. W. Seward Webb, one of the trustees of the University of Vermont, has given it $6,000 for the purchase of the herbarium of Cyrus G. Pringle.

The American Museum of Natural History, New York City, has sent an expedition to eastern Colorado to examine the unexplored portions of the Protohippus Beds in the hope of securing a complete skeleton of this animal. At the same time search will be made in western Nebraska for the same fossil species of horse, in the locality where Professor Leidy first discovered it. The expenses of these expeditions are defrayed by the gift of Mr. William C. Whitney.

The *Windward* is being fitted for its fifth and last trip and will soon sail via Etah for Cape Sabine on Smith Sound, where it is expected that Lieutenant Peary will be found.

A bill is now before the British parliament which if passed will make still more stringent the provision interfering with experiments on living animals in Great Britain. The *British Medical Journal* thus sums up the proposed new legislation: (1) The abolition of all anesthetics which are not respirable. (2) The

abolition of the use of curare. (3) The abolition of the application by way of experiment to the conjunctiva of any matter or substance for absorption. (4) The abolition of all experiments in which the animal is kept alive after an operation under anesthetics (Certificate B). (5) The abolition of all experiments as an illustration of lectures in a medical school where, as at present, the animals are kept under an anesthetic during the whole of the experiment, and killed before recovering consciousness (Certificate C). (6) To kill or to administer, and keep under, a respirable anesthetic every animal which has been subjected to an operation not calculated to give pain, should it begin to suffer pain after the operation (Certificate A). (7) The presence of an inspector during and throughout the whole course of every experiment which is calculated to cause pain, although the animal is under an anesthetic and is killed before regaining consciousness. (8) No license to be granted for more than one experiment or for one series of not more than six connected and consecutive experiments. (9) Every license shall specify the time and place of each experiment or series of experiments. (10) A detailed chronological report of the description, course and result of each experiment is to be sent to the Secretary of State within *seven days* after the completion of each experiment.

THE *Electrical World and Engineer* states that the committee for the 'Galileo Ferraris Award,' instituted in 1898, and composed of the representatives of the executive committee for the General Italian Exhibition, held in Turin, in 1898, of the chamber of arts and commerce, of the Royal Academy of Science and of the Royal Industrial Museum in Turin, have decided to open an international competition for the award of said prize on the occasion of the unveiling of the monument to Ferraris, in Turin, in the latter half of the month of September next. The award is 15,000 lires ($3,000), together with the compound interest accumulated since the year 1899 up to the day of the award. It will be granted to the inventor of some practical application of electricity likely to lead to noteworthy progress. Competitors may submit either pamphlets, projects and drawings, or machines, apparatus and appliances relating to their invention. The jury, composed of the aforesaid committee, shall have full power to cause practical experiments to be made upon the inventions entered for competition, and upon the corresponding apparatus. Competitors are to file their application and deliver their credentials appertaining to their invention not later than September 15, 1902, at the office of the secretary of the committee, care of the Adminstrative Committee on the First International Exhibition of Modern Decorative Art in the buildings of the Chamber of Commerce and Art, 28 Via Ospedale, Turin, Italy.

THE deep well borings of the United States, made for water, oil and gas, are the subject of a statistical report by N. H. Darton, in the series of Water-Supply and Irrigation Papers of the United States Geological Survey. The list of deep wells is arranged by States, in alphabetical order, and appears in two pamphlets known as Water-Supply Papers Nos. 57 and 61. All wells 400 feet or over in depth are carefully listed. Depth, diameter, yield per minute, and other characteristic data are given, and many instructive details are noted indicating for what purpose the borings were originally made, the character of the product obtained, and whether the wells are in use or abandoned. For the benefit of persons desiring more detailed information concerning wells in any particular region, references are given to the literature or other sources from which the data were obtained.

UNIVERSITY AND EDUCATIONAL NEWS.

PRESIDENT REMSEN, of the Johns Hopkins University, has succeeded in securing the million-dollar endowment fund, to which we have called attention. This money is to be used for supporting the educational work of the university and not for the erection of buildings on the new site, as has in some places been stated.

ALUMNI and friends of Amherst College have given $65,000 to build an observatory for the

astronomical department and for an observatory house, to be occupied by the astronomer, Professor D. P. Todd.

MRS. ANNE ELIZA WALSH, of Brooklyn, has given $450,000 to a board incorporated under the laws of New York State, the interest to be used for the education of candidates for the priesthood of the Roman Catholic Church.

GOVERNOR AARON T. BLISS has given $21,000 to Albion College, Albion, Mich.

DR. CONAN DOYLE has given $5,000 of the $7,000 cleared on his pamphlet 'The War in South Africa' for a scholarship which shall enable some poor South African, either Boer or British, to take a course in Edinburgh University.

ACCORDING to the statistics for the entering class at Yale University next year the numbers in the academic department will be about the same as last year, and the numbers in the Sheffield Scientific School show an increase of about twelve per cent.

PROFESSOR WILLIAM LOWE BRYAN, head of the departments of philosophy and pedagogy, has been elected President of the University of Indiana.

DR. E. H. LINDLEY has been appointed professor of psychology and Dr. J. A. Bergström, professor of pedagogy, at the same institution.

MR. JOHN HAYS HAMMOND has been appointed professor of mining engineering in the Sheffield Scientific School of Yale Unversity. Mr. Hammond graduated from the Sheffield Scientific School in 1876 and is a prominent consulting engineer.

DR. P. A. FISH has been promoted to a full professorship of comparative physiology and pharmacology at Cornell University.

Two appointments have been made at the newly established college of Clark University —Mr. Rufus C. Bentley, now fellow in pedagogy at the University, to be dean and professor of Latin and Greek, and Mr. Frederick H. Hodge, now fellow in mathematics, to be instructor in mathematics.

THE following announcements were made at the commencement exercises of Washington University: Robert Heywood Fernald, graduate of the Maine State College in mechanical engineering, 1892; assistant professor of mechanical engineering in Case School of Applied Science, 1896–1900; M.E., Case School, 1898; M.A., Columbia, 1901; Ph.D., 1902; appointed professor of mechanical engineering in place of Professor J. H. Kinealy, who resigns to go into the practice of his profession in Boston. Arthur W. Greeley, A.B., Stanford, 1896; A.M., 1899; Ph.D., Chicago, 1902; appointed assistant professor of zoology. A single course in this subject has been given during the past year by Mr. S. M. Coulter, who hereafter will devote himself exclusively to botany. Frederick M. Mann, C.E., Minnesota, 1898; M.S. in architecture, Massachusetts Institute of Technology, 1895; instructor in architectural design in the University of Pennsylvania, 1895–98; practicing architect in Philadelphia, 1898–1902; appointed professor of architecture. Sherman Leavitt, B.S. in chemistry, Washington University, 1900; and Samuel W. Forder, B.S. in chemistry, Washington University, 1902; appointed instructors in chemistry. These two appointments are to take the place of Doctor Gellert Alleman, who becomes professor of chemistry in Swarthmore College. P. R. Goodwin, graduate of the University of Maine in civil engineering, 1900; instructor in same institution, 1900–1901; appointed instructor in civil engineering.

DR. W. A. P. MARTIN has accepted the presidency of the new university at Wu-Chang, China.

PROFESSOR WISLICENUS, of Wurzburg, has been called to Tübingen, to succeed the late Dr. von Pechmann as director of the Chemical Institute of the University; Dr. Paul Hensel, of Heidelberg, has been called to the professorship of systematic philosophy at the University at Erlangen; Dr. Alfred Schaper has been appointed a chief of division in the Anatomical Institute at Breslau and Dr. von Gerichten, director of the Institute for Chemical Technology at the University at Jena.